HTH HR-1680

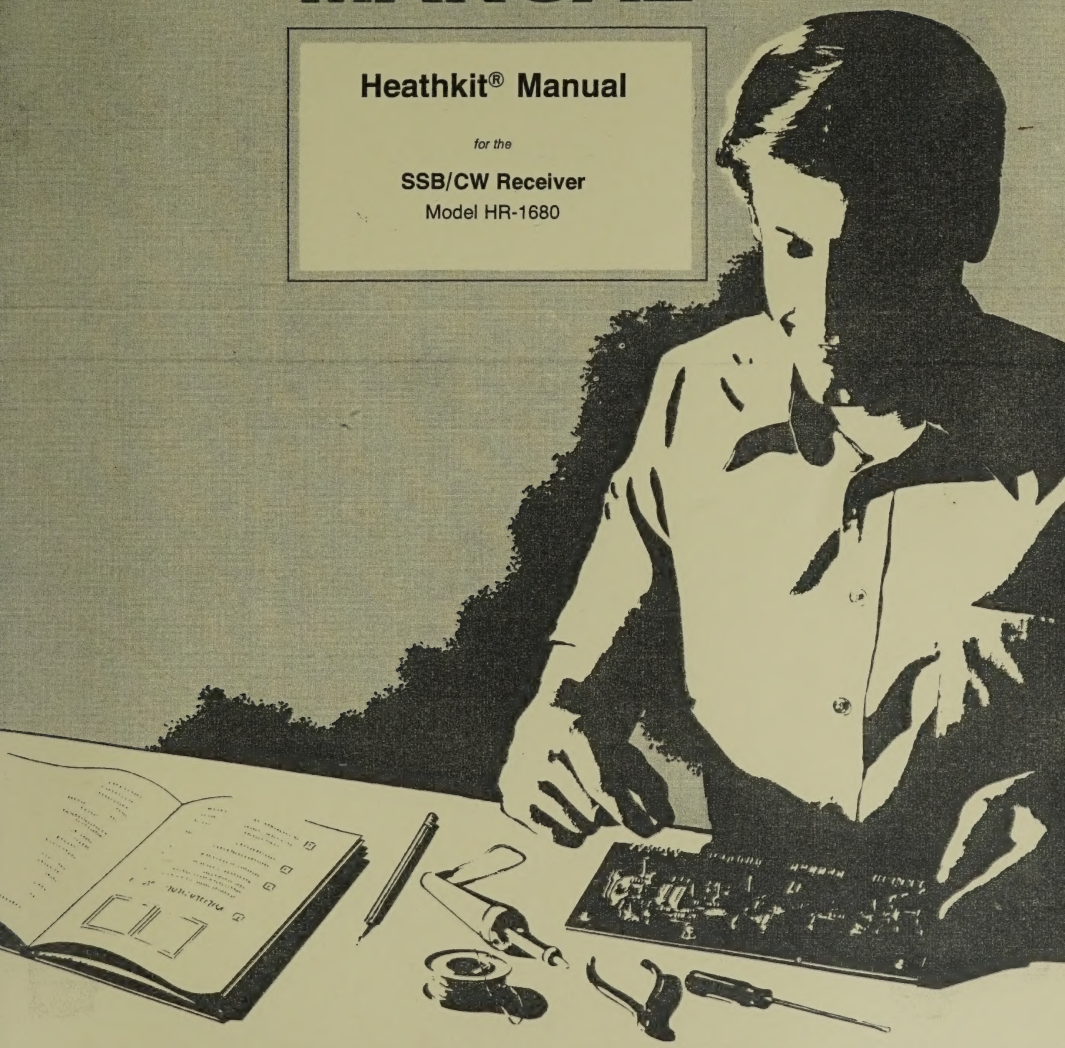
HEATHKIT® MANUAL

Heathkit® Manual

for the

SSB/CW Receiver

Model HR-1680



HEATH COMPANY · BENTON HARBOR, MICHIGAN

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for the

SSB/CW Receiver

Model HR-1680

595-1830-01

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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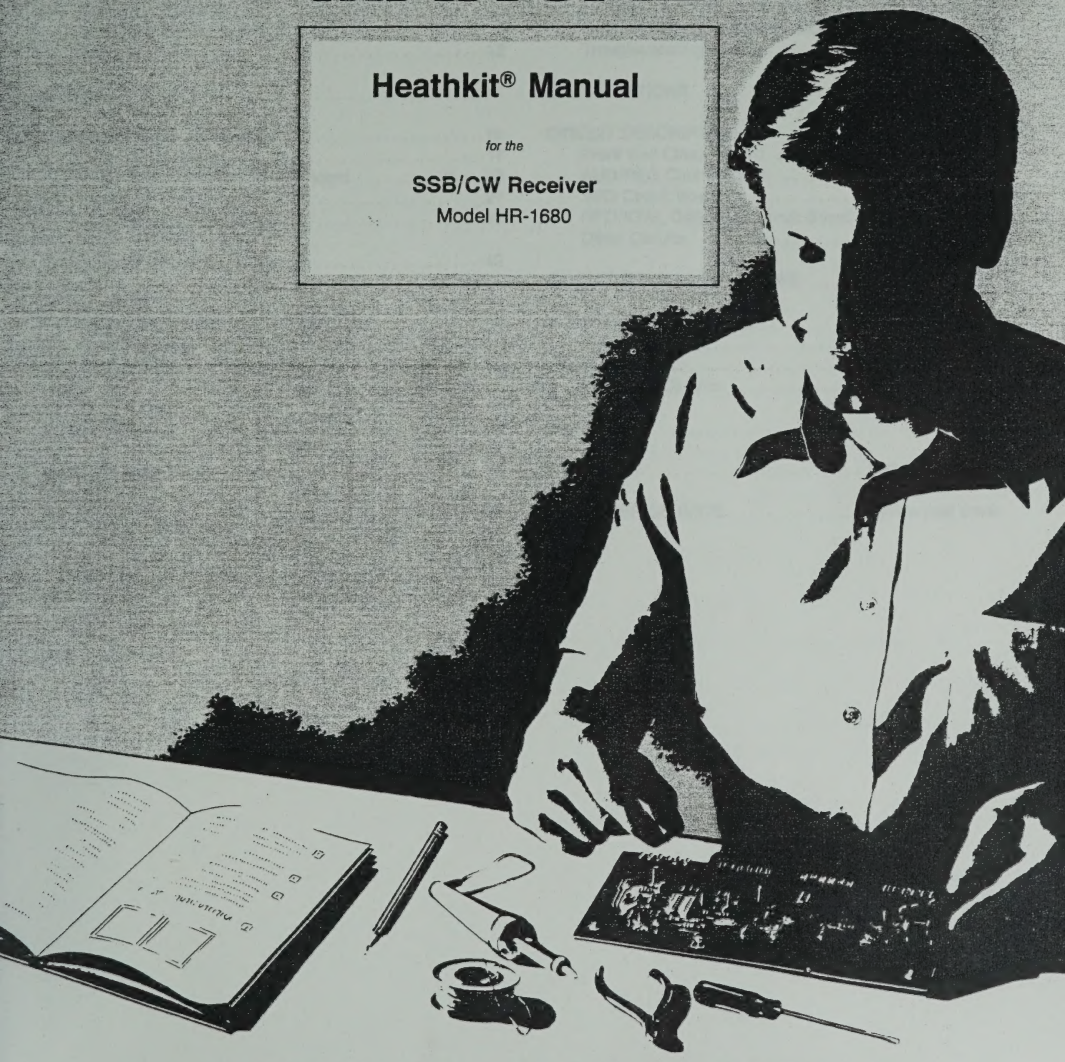

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UNPACKING

The Receiver shipping carton contains individual packs marked Pack #1, Pack #2, Pack #3, and Pack #4 (2 bags). After you remove all of these packs, the remaining packs and loose parts in the shipping carton form Parts Pack #5, which contains items too large to fit into the other parts packs, parts used for several circuit boards, and those items which you will use in the chassis assembly section.

This Manual contains a separate Parts List for each assembly section. At the beginning of each Parts List, you will be instructed which parts pack to open. You will also be directed to remove certain required parts form Pack #5.

To avoid intermixing parts, do not remove or open any of the parts packs until you are directed to do so at the beginning of one of the Parts Lists.

PARTS LISTS

The following pages contain several Parts Lists, one for each major section of this kit (Front End Circuit Board, Chassis, etc.). Check the parts and assemble this kit in the following manner:

1. Open the pack as directed in the step at the beginning of the Parts List.
2. Check the parts against the list.
3. Proceed to the assembly section, as directed at the end of the list.
4. After you complete the assembly section, return, as directed, to the next Parts List.
5. Repeat the process for each Parts List and assembly section.

Remove the Parts Pictorial from the "Illustration Booklet" and place it in a convenient location where you can refer to it during the assembly of this kit. Many parts in the Parts List are keyed to the Parts Pictorial for identification. Other parts not shown on the Parts Pictorial have the part numbers stamped on them.

After you identify any part that is packed in an individual envelope with the part number on it, place the part back in its envelope until that part is called for in a step. Some envelopes have a transparent side so you can identify the parts inside without opening the envelope. Do not throw away any packing materials until all the parts are accounted for.

Each circuit part in this kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

- In the Parts List,
- At the beginning of each step where a component is installed,
- In some illustrations,
- In the Schematic,
- In the sections at the rear of the Manual.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For price information, refer to the separate "Heath Parts Price List."

VFO CIRCUIT BOARD

Remove the pack marked #1 and check each part against the following list.

RESISTORS, 1/2-watt

NOTES:

1. Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.

2. The following resistors have a tolerance of 10% unless otherwise noted. 10% is indicated by a fourth color band of silver; 5% is indicated by a gold fourth band.

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A2	1-1	2	47 Ω (yellow-violet-black)	R302, R314
A2	1-3	2	100 Ω (brown-black-brown)	R311, R316
A2	1-175	1	120 Ω, 5% (brown-red-brown)	R303
A2	1-131	1	620 Ω, 5% (blue-red-brown)	R304
A2	1-7	1	680 Ω (blue-gray-brown)	R315
A2	1-46	2	3900 Ω (orange-white-red)	R309, R313
A2	1-16	1	4700 Ω (yellow-violet-red)	R308
A2	1-22	2	22 kΩ (red-red-orange)	R305, R312
A2	1-29	1	220 kΩ (red-red-yellow)	R307
A2	1-35	1	1 MΩ (brown-black-green)	R301

CAPACITORS

Disc

B2	21-168	2	4.7 pF	C307, C308
B2	21-3	1	10 pF	C305
B2	21-190	2	50 pF	C301, C303
B2	21-56	1	470 pF	C311
B2	21-191	3	510 pF	C302, C304, C306
B2	21-176	3	.01 μF	C309, C312, C313

Mica

B1	20-108	1	200 pF	C317
B1	20-112	1	310 pF	C318
B1	20-139	1	330 pF	C314
B1	20-116	1	400 pF	C316
B1	20-107	1	680 pF	C315

INDUCTORS

C1	40-1684	3	3.75 μH toroid	L302, L303, L304
C1	40-1800	1	1.3 μH toroid	L305
C2	40-1859	1	Variable inductor	L301
C3	45-82	1	350 μH choke	RFC301

DIODES

D1	56-89	1	GD510	D302
D1	56-19	1	VR-9.1	ZD301
D1	56-24	1	1N458	D301

TRANSISTORS

NOTE: Transistors may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

E1	417-169	2	MPF105	Q301, Q302
E3	417-801	1	MPSA20	Q304
E1	417-234	1	2N3638A	Q303

MISCELLANEOUS

R1	10-311	1	5 kΩ control	R306
H1	432-121	4	PCB pin	
H2	432-123	6	Circuit board connector	
R2	215-63	1	Heat sink	
R3	206-502	1	Coil shield	
			Solder	

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

PARTS FROM PACK #5 (parts in the shipping carton)

NOTE: Remove the wire bundle. Cut off lengths when you are directed to do so by the assembly steps in the various sections of this Manual.

	Wire	bundle consists of:
340-1	*7-1/2'*	*Large bare wire*
340-2	*3'*	*Small bare wire*
343-15	*1'*	*Shielded cable*
344-52	*4-1/2'*	*Red wire*
344-58	*8'*	*Gray wire*
346-1	*1-1/2'*	*Sleeving*

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

Parts From Pack #5 (parts in the shipping carton) cont'd.

85-1731-2	1	VFO circuit board
390-1045	1	Terminal identification label
391-34	1	Blue and white label
597-260	1	Parts Order Form
	1	Assembly Manual (See front cover for part number.)
	1	Illustration Booklet

Proceed to "Assembly Notes" on Page 14.

HFO/XTAL CALIBRATOR CIRCUIT BOARD

Remove the pack marked #2 and check each part against the following list.

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

RESISTORS, 1/2-Watt

NOTES:

1. Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.

2. The following resistors have a tolerance of 10% unless otherwise noted. 10% is indicated by a fourth color band of silver; 5% is indicated by a gold fourth band.

A2	1-1	1	47 Ω (yellow-violet-black)	R421
A2	1-3	1	100 Ω (brown-black-brown)	R417
A2	1-66	1	150 Ω (brown-green-brown)	R418
A2	1-45	2	220 Ω (red-red-brown)	R414, R427

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

Resistors (cont'd.)

A2	1-9	8	1000 Ω (brown-black-red)	R402, R404, R406, R408, R411, R413, R424, R426
A2	1-44	1	2200 Ω (red-red-red)	R419
A2	1-18	1	5600 Ω (green-blue-red)	R422
A2	1-21	6	15 kΩ (brown-green-orange)	R401, R403, R405, R407, R409, R412
A2	1-22	1	22 kΩ (red-red-orange)	R416
A2	1-25	2	47 kΩ (yellow-violet-orange)	R415, R425
A2	1-29	1	220 kΩ (red-red-yellow)	R423

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
CAPACITORS				
Disc				
B2	21-33	1	3.3 pF	C419
B2	21-157	2	5 pF	C403, C409
B2	21-181	2	7.7 pF	C402, C406
B2	21-3	2	10 pF	C404, C424
B2	21-7	1	33 pF	C427
B2	21-22	2	220 pF	C413,C416
B2	21-176	7	.01 μF	C401, C405, C407, C411, C414, C417, C422
B2	21-95	3	.1 μF	C421, C423, C426
Mica				
B1	20-77	1	24 pF	C408
B1	20-101	1	47 pF	C412
B1	20-102	2	100 pF	C415, C418
INDUCTORS				
C4	40-687	5	0.5 μH coil (green dot)	L401, L402, L403, L404, L405
C4	40-1047	1	1.42 μH coil (gray dot)	L406
C5	45-73	1	2.2 μH choke	L407
DIODES-TRANSISTORS				
D1	56-26	1	1N191(brown-white-brown)	D415
D1	56-24	12	1N458	D401, D402 D403, D404, D405, D406, D408, D409, D411. D412, D413, D414
D1	56-16	1	1N751	ZD401

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Diodes-Transistors (cont'd.)				

NOTE: Transistors may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

E3	417-801	2	MPSA20	Q403, Q404
E3	417-293	2	2N5770	Q401, Q402
CRYSTALS				
G2	404-43	1	100 kHz	Y407
G1	404-207	1	12.395 MHz	Y406
G1	404-208	1	15.895 MHz	Y405
G1	404-209	1	22.895 MHz	Y404
G1	404-210	1	29.895 MHz	Y403
G1	404-211	1	36.895 MHz	Y402
G1	404-212	1	37.395 MHz	Y401
MISCELLANEOUS				
R4	31-52	1	8-60 pF trimmer	C425
H1	432-121	1	PCB pin	
H3	432-124	12	Circuit board connector	
R5	475-10	1	Ferrite bead	
N2	250-56	2	6-32 x 1/4" screw	
N15	254-1	2	#6 lockwasher	
N18	255-142	2	6-32 x 5/8" spacer	
PART FROM PACK #5				
	85-1732-1	1	HFO/XTAL calibrator circuit board	

Proceed to "HFO/XTAL Calibrator Circuit Board" assembly on Page 22.

FRONT END CIRCUIT BOARD

Remove the pack marked #3 and check each part against the following list.

RESISTORS, 1/2-Watt

NOTES:

1. Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.

2. The following resistors have a tolerance of 10% unless otherwise noted. 10% is indicated by a fourth color band of silver; 5% is indicated by a gold fourth band.

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A2	1-1	9	47 Ω (yellow-violet-black)	R102, R103, R104, R105, R114, R116, R117, R118, R119
A2	1-3	4	100 Ω (brown-black-brown)	R123, R126, R129, R133
A2	1-45	2	220 Ω (red-red-brown)	R125, R131
A2	1-42	1	270 Ω (red-violet-brown)	R108
A2	1-8	1	820 Ω (gray-red-brown)	R109
A2	1-9	2	1000 Ω (brown-black-red)	R101, R106
A2	1-13	2	2700 Ω (red-violet-red)	R113, R115
A2	1-14	1	3300 Ω (orange-orange-red)	R128
A2	1-16	1	4700 Ω (yellow-violet-red)	R112
A2	1-20	2	10 kΩ (brown-black-orange)	R111, R134
A2	1-22	2	22 kΩ (red-red-orange)	R121, R127
A2	1-25	1	47 kΩ (yellow-violet-orange)	R122
A2	1-26	3	100 kΩ (brown-black-yellow)	R107, R124, R132

CAPACITORS

Mica

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B1	20-52	2	7.5 pF	C141, C144
B1	20-101	1	47 pF	C103
B1	20-147	2	75 pF	C112, C124
B1	20-176	2	94 pF	C109, C121
B1	20-124	1	115 pF	C145
B1	20-104	2	130 pF	C138, C142,
B1	20-126	2	255 pF	C105, C106

Mica (cont'd.)

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B1	20-113	1	470 pF	C154
B1	20-122	1	1000 pF	C153
B1	20-127	1	1300 pF	C107

Disc

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B2	21-78	1	5 pF	C116
B2	21-3	3	10 pF	C133, C135, C143
B2	21-7	2	33 pF	C134, C149
B2	21-13	1	500 pF	C108
B2	21-176	17	.01 μF	C104, C111, C113, C114, C115, C117, C118, C122, C125, C127, C129, C132, C136, C137, C147, C151, C152

Other

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B3	31-68	6	1-8 pF trimmer	C119, C123, C126, C128, C131, C155
B13	31-76	2	8-40 pF trimmer	C139, C146
B4	25-117	1	100 μF electrolytic	C148

INDUCTORS

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	40-1862	2	.25 μH (blue dot)	L102, L105
C1	40-1866	1	.76 μH (orange dot)	L115
C6	40-1789	1	1.0 μH toroid	L109
C1	40-1869	3	1.31 μH (green dot)	L103, L104, L114
C1	40-1870	1	1.59 μH (red dot)	L113
C6	40-1788	1	1.8 μH toroid	L108
C7	40-1805	3	2.25 μH toroid	L116, L117, L118
C1	40-1874	1	3.8 μH (blue dot)	L112
C6	40-1787	1	4.7 μH toroid	L107
C1	40-1732	2	10.1 μH toroid	L111, L119

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Inductors (cont'd.)				
C6	40-1786	1	13 μH toroid	L106
C8	40-487	1	300 μH peaking coil (orange-black-brown)	RFC102
C3	45-82	1	350 μH RF choke	RFC101
C9	40-1888	1	3.395 MHz trap	TC101
DIODES-TRANSISTORS				
D1	56-24	17	1N458 diode	D101, D102, D103, D104, D105, D106, D107, D108, D109, D111, D112, D113, D114, D115, D116, D117, D118

NOTE: Transistors may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Diodes-Transistors (cont'd.)				
E2	417-863	3	MFE131 transistor	Q101, Q102, Q103
E1	417-201	1	X29A829 transistor	Q104
MISCELLANEOUS				
H1	432-121	2	PCB pin	
H3	432-124	18	Circuit board connector	
R5	475-10	5	Ferrite bead	
N2	250-56	2	6-32 x 1/4" screw	
N15	254-1	2	#6 lockwasher	
N18	255-142	2	6-32 x 5/8" spacer	
PART FROM PACK #5				
	85-1846-3	1	Front end circuit board	

Proceed to "Front End Circuit Board" assembly on Page 27.

AUD/REG CIRCUIT BOARD

Remove the packs (2) marked #4 and check each part against the following list.

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS				

NOTES:

1. Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.
2. The following resistors have a tolerance of 10% unless otherwise noted. 10% is indicated by a fourth color band of silver; 5% is indicated by a gold fourth band.

1/4-Watt				
A1	1-51-12	3	47 Ω (yellow-violet-black)	R237, R248, R249

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
1/4-Watt (cont'd.)				
A1	1-1-12	7	100 Ω (brown-black-brown)	R203, R205, R221, R222, R229, R245, R253
A1	1-23-12	2	390 Ω (orange-white-brown)	R256, R257
A1	1-21-12	3	270 Ω (red-violet-brown)	R244, R247, R263
A1	1-92-12	1	330 Ω, 5% (orange-orange-brown)	R234
A1	1-40-12	1	680 Ω (blue-gray-brown)	R233
A1	1-24-12	2	820 Ω (gray-red-brown)	R224, R238
A1	1-2-12	4	1000 Ω (brown-black-red)	R239, R241, R242, R243
A1	1-3-12	1	1200 Ω (brown-red-red)	R232

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
1/4-Watt (cont'd.)				
A1	1-36-12	2	1500 Ω (brown-green-red)	R261, R262
A1	1-4-12	1	2200 Ω (red-red-red)	R254
A1	1-5-12	1	2700 Ω (red-violet-red)	R223
A1	1-6-12	1	3300 Ω (orange-orange-red)	R204
A1	1-7-12	1	3900 Ω (orange-white-red)	R259
A1	1-8-12	3	4700 Ω (yellow-violet-red)	R235, R236, R255
A1	1-27-12	1	6800 Ω (blue-gray-red)	R258
A1	1-9-12	2	10 kΩ (brown-black-orange)	R228, R231
A1	1-41-12	2	33 kΩ (orange-orange-orange)	R211, R212
A1	1-11-12	4	47 kΩ (yellow-violet-orange)	R251, R252, R264, R265
A1	1-31-12	2	68 kΩ (blue-gray-orange)	R216, R218
A1	1-32-12	5	100 kΩ (brown-black-yellow)	R214, R215, R217, R219, R226
A1	1-48-12	3	680 kΩ (blue-gray-yellow)	R207, R213, R225
A1	1-19-12	1	1 MΩ (brown-black-green)	R227
A1	1-111-12	2	1.5 MΩ, 5% (brown-green-green)	R208, R209
1/2-Watt				
A3	2-247	1	5000 Ω (5 k) precision	R202
A3	2-264	1	8500 Ω (8.5 k) precision	R201

CAPACITORS

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Mica				
B1	20-100	2	30 pF	C249, C252
B1	20-102	2	100 pF	C251, C253
B1	20-149	1	150 pF	C235
B1	20-178	1	160 pF	C237
Disc				
B2	21-3	3	10 pF	C231, C243, C244
B2	21-9	1	100 pF	C248
B2	21-17	1	270 pF	C247
B2	21-140	1	.001 μF	C233
B2	21-25	1	.0013 μF (1300 pF)	C204
Disc (cont'd.)				
B2	21-176	14	.01 μF	C208, C225, C227, C229, C230, C232, C234, C236, C238, C239, C241, C242, C245, C246
B2	21-95	1	.1 μF	C228
Electrolytic				
B5	25-256	1	.47 μ (tantalum)	C206
B5	25-123	1	2 μF	C224
B6	25-221	3	2.2 μF (tantalum)	C215, C216, C223
B4	25-233	1	22 μF	C217
B6	25-223	1	47 μF (tantalum)	C207
B4	25-117	3	100 μF	C209, C219, C226
B4	25-160	1	250 μF	C205
B4	25-148	1	1000 μF	C202
Other				
B7	28-4	2	1.5 pF phenolic (brown-green-white-silver)	C254, C256
B8	29-5	4	1000 pF polystyrene	C211, C212, C213, C214
B9	27-47	3	.1 μF Mylar*	C201, C218, C221

INDUCTORS

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C10	40-821	1	2.83 MHz coil	TC201
C1	40-1877	1	13.2 μH toroid (yellow and white dots)	L202
C7	40-1881	1	13.9 μH toroid (yellow dot)	L201

DIODES-TRANSISTORS-INTEGRATED CIRCUITS (IC's)

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
D1	56-26	3	1N191 diode (brown-white-brown)	D205, D206, D207
D1	56-50	1	DO-7 zener diode	ZD201

*DuPont Registered Trademark

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

Diodes-Transistors-Integrated Circuits (IC's) (cont'd.)

NOTE: Transistors and integrated circuits may be marked for identification in any of the following four ways:

1. Part number.
2. Part number. (On integrated circuits, this refers only to the numbers; the letters may be different or missing.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

E1	417-241	1	EL131	Q204
E1	417-169	2	MPF105 transistor	Q208, Q209
E3	417-801	3	MPSA20 transistor	Q203, Q206, Q207
E1	417-201	1	X29A829 transistor	Q202
E2	417-863	1	MFE131 transistor	Q205
E4	417-852	1	TIP31 transistor	Q201
F1	442-602	1	LM324N IC	IC203
F3	442-96	1	MC1496G IC	IC204
F2	442-626	1	78MGT4C IC	IC201
F1	442-610	1	TBA820L IC	IC202

CRYSTALS

G1	404-205	1	3393.6 kHz	Y205
G1	404-206	1	3396.4 kHz	Y206

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

Crystals (cont'd.)

	404-331	1	Filter set consists of:	
G1		2	*3393.8 kHz (3.3938 MHz)*	*Y201, Y204*
G1		2	*3395.05 kHz (3.39505 MHz)*	*Y202, Y203*

MISCELLANEOUS

R6	215-604	1	Heat sink	
R7	260-56	2	Fuse clip	
K3	421-29	1	3/4-ampere, slow-blow fuse	F201
H3	432-124	18	Circuit board connector	
H4	434-267	1	14-pin (staggered pin) IC socket	
H5	434-298	1	14-pin (in-line) IC socket	
R5	475-10	2	Ferrite bead	
M1	250-273	2	4-40 × 3/8" screw	
M2	252-15	2	4-40 nut	
M3	254-9	2	#4 lockwasher	
N1	253-2	1	#6 fiber shoulder washer	
N2	250-56	2	6-32 x 1/4" screw	
N15	254-1	2	#6 lockwasher	
N18	255-142	2	6-32 x 5/8" spacer	
	490-5	1	Plastic nut starter	

PART FROM PACK #5

	85-1734-5	1	AUD/REG circuit board

Proceed to "AUD/REG Circuit Board" assembly on Page 33.

CHASSIS

Unpack the remaining parts. Then check each part against the following list.

RESISTORS, 1/2-Watt

NOTE: The following resistors have a 10% tolerance (silver fourth band).

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A2	1-1	1	47 Ω (yellow-violet-black)	R2
A2	1-8	1	820 Ω (gray-red-brown)	R8
A2	1-25	1	47 kΩ (yellow-violet-orange)	R6
A2	1-20	1	10 kΩ (brown-black-orange)	R3
A2	1-34	1	680 kΩ (blue-gray-yellow)	R5

CAPACITORS

B10	26-153	1	VFO capacitor	C3
B11	26-151	1	Preselector capacitor	C1A/C1B
B9	27-47	2	.1 μF Mylar	C4, C5
B12	25-208	1	1500 μF electrolytic	C2

DIODES

D1	56-89	1	GD510	D5
D1	57-65	4	1N4002	D1, D2, D3, D4

CONTROLS-SWITCHES

J1	10-27	1	3000 (3 k) Ω control	R1
J2	10-180	1	15 kΩ control	R7
J3	19-721	1	100 kΩ control with switch	R4/SW1
J4	60-22	2	Slide switch	SW2, SW3
J5	63-1254	1	Wafer switch	SW4A/SW4B

OTHER ELECTRONIC PARTS

	54-915	1	Power transformer	T1
K1	407-716	1	Meter	M1
K2	412-58	2	#1813 lamp	PL1, PL2
K3	421-31	1	3/16-ampere fuse	F1

HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW #4, HDW #6, etc.). You may have to open more than one packet in this pack to locate all of the hardware of any one (#6, for example) size.

#3 Hardware

KEY No.	PART No.	QTY.	DESCRIPTION
L1	250-49	2	3-48 x 1/4" screw
L2	252-1	2	3-48 nut
L3	254-7	2	#3 lockwasher

#4 Hardware

M4	250-285	7	4-40 x 1/4" screw
M5	250-375	3	4-40 x 5/16" flat head screw
M6	250-248	7	4-40 x 1/2" self-tapping screw
M7	250-312	2	4-40 x 3/4" screw
M8	252-15	5	4-40 nut
M9	254-9	7	#4 lockwasher

#6 Hardware

N2	250-56	7	6-32 x 1/4" screw
N3	250-1157	3	6-32 hex spacer
N4	250-381	4	6-32 x 3/8" black screw
N5	250-89	38	6-32 x 3/8" screw
N6	250-218	4	6-32 x 3/8" phillips head screw
N7	250-155	8	#6 x 3/8" black sheet metal screw
N8	250-1187	1	6-32 x 1-1/4" black flat head screw
N9	250-162	8	6-32 x 1/2" screw
N10	250-406	1	6-32 x 5/8" flat head screw
N11	250-40	2	6-32 x 1-1/2" screw
N12	252-3	55	6-32 nut

KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
#6 Hardware (cont'd.)				
N13	253-60	8	#6 flat washer	
N14	253-89	1	#6 "D" washer	
N15	254-1	68	#6 lockwasher	
N16	254-6	1	#6 external tooth lockwasher	
N17	259-1	12	#6 solder lug	
#8 Hardware				
P1	250-43	6	8-32 x 1/4" setscrew	
P2	250-18	2	8-32 x 3/8" screw	
P3	252-4	2	8-32 nut	
P4	254-2	2	#8 lockwasher	
Other Hardware				
Q1	252-7	4	Control nut	
Q2	252-146	2	Window retainer	
Q3	252-10	2	Push-on nut	
Q4	253-10	4	Control flat washer	
Q5	253-59	3	Spring washer	
Q6	254-4	2	Control lockwasher	
Q7	255-2	2	3/16" spacer	
Q8	255-49	4	5/16" spacer	
Q9	255-77	3	7/16" spacer	
Q10	259-10	2	Control solder lug	
SHEET METAL PARTS				
S1	90-1200-1	1	Cabinet top	
S2	90-1201-1	1	Cabinet bottom	
S3	200-1256	1	Chassis	
S4	203-1750-1	1	Front panel	
S5	203-1751-1	1	Rear panel	
S6	204-2003	2	Meter bracket	
S7	204-2154	1	VFO bracket	
S8	204-2155	1	Capacitor mounting bracket	
S9	204-2156	1	Pressure plate	
S10	205-756	1	Drive mounting bracket	
S11	205-761	1	Dial drive plate	
S12	205-1648	1	Spacer plate	
S13	206-1206	1	VFO shield	
S14	206-1235	2	Circuit board shield	

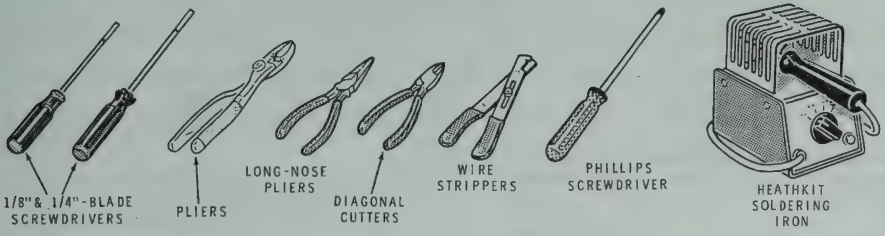
KEY No.	PART No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
CONNECTORS				
H6	432-72	2	Male terminal	
H7	432-73	20	Female terminal	
H8	432-120	7	PCB connector	
H9	432-180	12	Chassis connector	
H10	432-196	1	Male terminal housing	
H11	432-808	3	Extender terminal housing	
H12	432-907	1	Female terminal housing	
H13	434-42	5	Phono socket	
H14	436-4	1	Phone jack	
H15	438-4	3	Phono plug	
MISCELLANEOUS				
R8	75-71	1	Strain relief	
R9	75-61	8	Cabinet nut	
	89-23	1	Line cord	
R10	100-1041	2	Vernier drive	
	134-949	1	Wire harness	
R11	206-86	2	Lamp shield	
R12	207-22	1	Cable clamp	
R13	255-59	2	Tapered spacers	
R14	261-9	4	Round foot	
R15	266-200	1	Clutch plate	
R16	261-41	1	Square foot	
R17	391-98	1	Nameplate	
R18	422-1	1	Fuse block	
R19	431-26	1	1-lug terminal strip	
R20	431-81	2	6-lug terminal strip	
R21	434-44	2	Lamp socket	
R22	446-663	1	Dial window	
R23	462-288	1	Pushbutton	
R24	462-906	1	Large knob	
R25	462-933	4	Small knob	
R26	463-67	1	Dial pointer	
R27	464-73	1	Tuning dial	
R28	490-1	1	Alignment tool	
R29	205-778	1	1" steel blade	

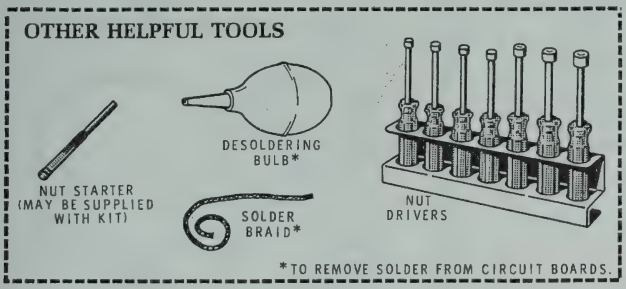
Proceed to "Chassis Assembly" on Page 42.

ASSEMBLY NOTES

TOOLS

You will need these tools to assemble your kit.





OR

PENCIL SOLDERING IRON (25 TO 40 WATTS)

ASSEMBLY

1. Follow the instructions carefully, and read the entire step before you perform the operation.

2. Position all parts as shown in the Pictorials.

3. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

4. A separate "Illustration Booklet" contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. When the Manual says to refer to a certain Pictorial or Detail and that illustration is not on the same page, or on the page across from it, refer to the "Illustration Booklet."

   Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

5. Solder a part or a group of parts only when you are instructed to do so.

ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the U.S.A., 120 VAC is most often used, while in many other countries 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 VAC Wiring

Refer to Detail 5-14D Part A for the following steps.

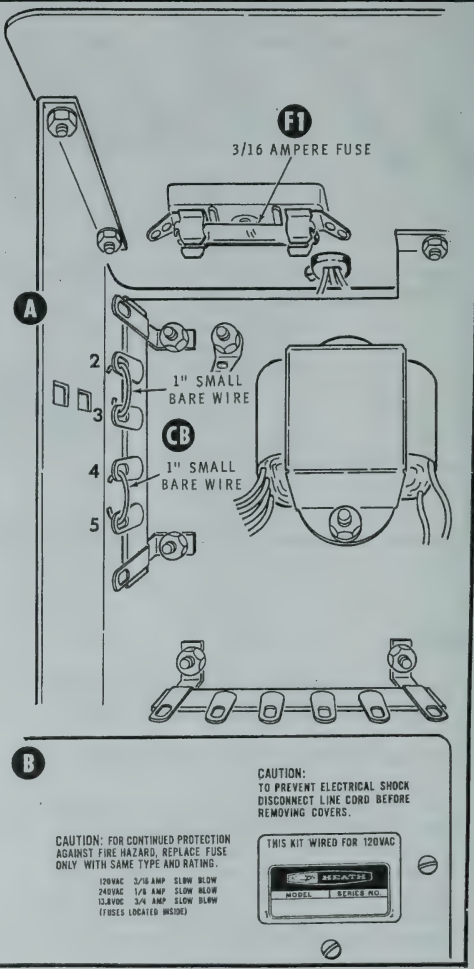
( ) Cut two 1" lengths of small bare wire.

( ) Connect a 1" small bare wire between terminal strip CB lugs 2 (S-3) and 3 (S-2). Make mechanically secure connections.

( ) Connect a 1" small bare wire between terminal strip CB lugs 4 (S-2) and 5 (S-3). Make mechanically secure connections.

( ) F1: Insert a 3/16-ampere fuse into fuse block F1.

(✓) Carefully peel away the backing paper from the blue and white label. Then refer to Part B of the Detail and press the label onto the lower portion of the label outline on the rear panel as shown.



Detail 5-14D

240 VAC Wiring

Refer to Detail 5-14E Part A for the following steps.

( ) Cut a 1" length of small bare wire.

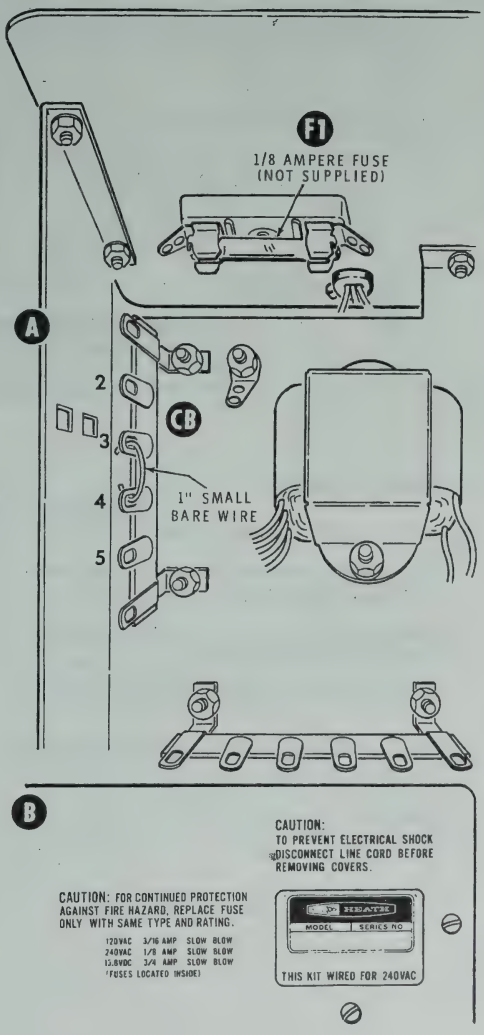
( ) Connect a 1" small bare wire between terminal strip CB lugs 3 (S-2) and 4 (S-2). Make mechanically secure connections.

( ) Solder the wires at terminal strip CB lug 2 (S-2).

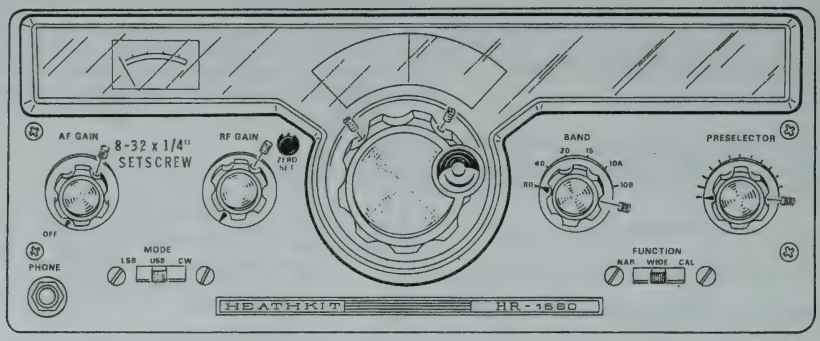
( ) Solder the wires at terminal strip CB lug 5 (S-2).

( ) F1: Insert a 1/8-ampere slow-blow fuse (not supplied) into fuse block F1.

(✓) Carefully peel away the backing paper from the blue and white label. Then refer to Part B of the Detail and press the label onto the upper part of the label outline on the rear panel as shown.



Detail 5-14E



PICTORIAL 5-15

KNOB INSTALLATION

Refer to Pictorial 5-15 for the following steps.

( ) Start an 8-32 x 1/4" setscrew into each of the four small knobs. Start two setscrews into the large knob.

( ) Except for the VFO (center) shaft, turn all of the front panel shafts fully counterclockwise.

( ) Place the large knob onto the VFO shaft and tighten the setscrews.

( ) Place four small knobs onto the shafts at AF Gain, RF Gain, Band, and Preselector. Position the knob index marks as shown in the Pictorial and tighten the setscrews.

This completes the assembly of your SSB/CW Receiver. Before you proceed to "Initial Tests," look it over carefully to be sure:

1. That all hardware is tightened.
2. There are no unsoldered connections.
3. There are no cutoff wire ends or solder splashes lodged in the wiring.
4. There are no protruding wire ends that could short to adjacent lugs.

INITIAL TESTS

The purpose of this section of the Manual is to make sure your Receiver operates properly and will not be damaged as a result of a wiring error. A transistor or other component, for example, could be destroyed instantly by a short circuit that causes excessive current.

RESISTANCE CHECKS

PRIMARY WIRING TESTS

A wiring error in the primary wiring circuit (line cord, On-Off switch, etc.) of your Receiver could cause you to receive a severe electrical shock. These "Primary Wiring Tests" will assure you that no such wiring errors exist.

( ) Be sure the line cord is not plugged in.

( ) Turn the AF GAIN control to OFF.

If you do not have an ohmmeter, carefully check the line cord, fuse block, switch SW1, and the transformer wiring against that shown in Pictorials 5-3, 5-4, 5-14, and Detail 5-14D or 5-14E. Make sure there are no fine strands of wire, or solder blobs, touching adjacent terminals or the chassis. Then proceed to "Sound Check" on Page 70.

If you have an ohmeter, perform the following resistance measurements.

( ) Turn on your ohmmeter and allow it to warm up, if necessary.

( ) Set your ohmmeter on the R X 10 range.

NOTE: When you are instructed to connect a lead to ground, connect the lead to the chassis.

METER CONNECTIONS		METER READING	POSIBLE CAUSE OF TROUBLE
RED LEAD	BLACK LEAD		
1. Either prong of the line cord plug.	Ground	INFINITE with the AF GAIN control ON or OFF.	A. Switch SW1 wiring. B. Terminal strip CB wiring. C. Fuse block wiring. D. T1.
2. Other flat prong of the line cord plug.	Ground	INFINITE with the AF GAIN control ON or OFF.	A. Switch SW1 wiring. B. Terminal strip CB wiring. C. Fuse block wiring D. T1.
3. Round prong of the line cord plug.	Ground	0 Ω with the AF GAIN control ON or OFF.	A. Green lead of the line cord not properly connected at solder lug CS. See Pictorial 5-14.
4. Either flat prong.	Other flat prong.	1 MΩ or higher (AF GAIN control OFF).	A. Terminal strip CB wiring. B. SW1 wiring.
5. Either flat prong.	Other flat prong.	Approximately 50-70 Ω for either 120 or 240 VA wiring (AF GAIN control ON).	A. Terminal strip CB wiring. B. SW1 wiring. C. Fuse F1. D. Fuse block wiring. F. T1.

This completes the "Primary Wiring Tests." If all tests were satisfactory, proceed to "Other Resistance Checks." If any of the tests were not correct, you must make the corrections necessary to obtain the correct readings before you continue.

OTHER RESISTANCE CHECKS

( ) Turn on your ohmmeter and allow it to warm up, if necessary.

( ) Set your ohmmeter on the RX10 range.

( ) Position the chassis bottom-side-up as shown in Figure 1-1 (in the "Illustration Booklet").

( ) Connect the common ohmmeter test lead to the chassis.

NOTE: The internal wiring of most ohmmeters is such that the positive terminal of the meter battery is connected to the positive test lead and the negative battery terminal is connected to the negative (common) test lead. In some ohmmeters this wiring is reversed and will give erroneous readings in the following measurements. Interchange the ohmmeter leads if the measurements do not check out correctly the first time.

Connect the positive ohmmeter test lead to the chassis connector terminals listed in the following chart and check your resistance readings. If your readings disagree with those given in each step, check the items listed in the "Possible Cause" column.

NOTE: Some of the readings, in the following steps, may take a few seconds to reach the indicated resistance due to the charging of capacitors.

TEST POINT TERMINAL	RESISTANCE IN OHMS	POSSIBLE CAUSE
( ) D18	INFINITY	1. D1-D4. 2. C2. 3. Q201. 4. IC201.
( ) D17	10-20 (approximate)	1. Wiring error on SW1. 2. Solder bridge on AUD/REG circuit board.
( ) D16	10-20 (approximate)	1. Wiring error at chassis connectors D16, D4, C7, B6, or A12. 2. Wiring error on SW3 or SW4. 3. Solder bridge on any circuit board.

VOLTAGE CHECKS

Preset the front panel controls and switches as follows:

AF GAIN ..... Off until it clicks.

RF GAIN ..... Fully clockwise.

BAND switch ..... 80.

MODE switch ..... LSB.

FUNCTION switch ..... Wide.

PRESELECTOR ..... Midrange.

( ) Connect the Receiver power cord to an AC outlet.

NOTE: The following voltage checks require the use of a high-impedance input (1 megohm or more) voltmeter. Voltage measurements are ±20%.

( ) Set your voltmeter to measure at least +20 VDC and connect the common lead to the chassis.

NOTE: If any of the following observations and checks fail, immediately turn the Receiver off and disconnect the line cord. Correct the problem before you proceed. Check the "Possible Causes" that follow each check.

( ) Rotate the AF GAIN control clockwise until it clicks. The dial lamps should light.

POSSIBLE CAUSE CHART

1. Dial lamps do not light.

   A. Wiring error on PL1 or PL2.
   B. Wiring error on R1.
   C. Wiring error on SW3.
   D. Wiring error on SW2.
   E. Wiring error on connector A12.
   F. PL1 and/or PL2.

Connect the positive voltmeter test lead to the chassis connector terminals listed in the following chart and check the voltage readings. If your readings disagree with those given in each step, check the items listed in the "Possible Cause" column.

TEST POINT TERMINAL	VOLTAGE (±20%)	POSSIBLE CAUSE
( ) D18	23	1. F1. 2. Wiring error on terminal strip CB. 3. D1-D4. 4. C2.
( ) D16	13.5	1. Q201. 2. IC201.
( ) D4	13.5	1. Wiring error at D16 or D4.
( ) C7	13.5	1. Wiring error at D16 or C7.
( ) A12	13.5	1. Wiring error at C7 or A12.
( ) B6	13.5	1. Wiring error at A12 or B6.

( ) Turn the AF GAIN control to Off.

SOUND CHECK

( ) Connect a 4 or 8-ohm speaker to the SPKR (speaker) jack on the rear panel.

( ) Connect the Receiver power cord to an AC outlet, if not already done.

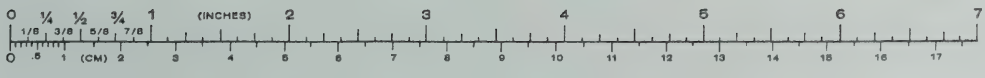
( ) Rotate the AF GAIN control fully clockwise. You should hear noise from the speaker.

( ) Turn the lamp shields on PL1 and PL2 for proper lighting at the meter and tuning dial.

POSSIBLE CAUSE CHART
1. No sound from speaker.
A. Speaker connections.
B. Wiring error on R4.
C. Wiring error on J3 or J4.
D. J3 defective.
E. Wiring error at connector D6.
F. IC202 or IC203.
G. Q208 or Y205 (LSB only).
H. Q209 or Y206 (USB only).

( ) Turn the AF GAIN control to Off.

This completes the "Initial Tests." Proceed to the "Alignment" section.



ALIGNMENT

You can completely align your Receiver without any external equipment. You may be able to improve the sensitivity by using a VTVM and an RF generator, but they are not necessary.

If you do not obtain the proper results during alignment, proceed to the "In Case of Difficulty" section on Page 83.

ALIGNMENT PREPARATION

Refer to Figure 2-1 for the following steps.

( ) Prepare a 12" gray wire.

( ) Solder a PCB connector on each end of the 12" wire.

Set this jumper wire aside. It will be used during "HFO Coil Alignment."

( ) Refer to Figure 2-2 and use a pair of pliers to push the 1" steel blade into the smaller end of the nut starter until 1/8" remains exposed. Use this tool when you are instructed to adjust trimmer capacitors.

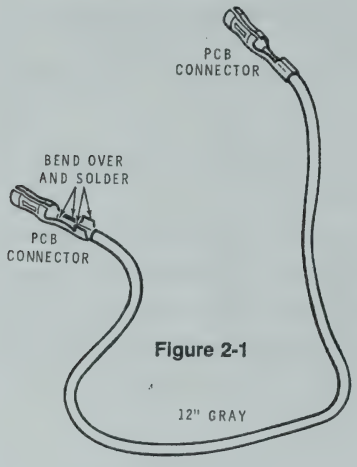


Figure 2-1

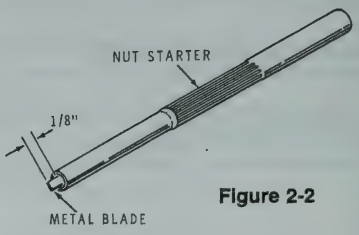


Figure 2-2

Refer to Figure 2-3 (in the "Illustration Booklet") for the following steps.

NOTE: The Figure shows only one extender assembly. You will actually be assembling three of these assemblies when you perform the following steps.

( ) Unfold and straighten the large bare wire as much as possible.

( ) Cut eighteen 4-1/2" lengths of large bare wire.

( ) Solder a female connector on one end of each of the 18 large bare wires.

( ) Cut the ears from the three extender terminal housings and the three remaining chassis connectors.

NOTE: Perform the next four steps three times, once for each extender assembly.

( ) ( ) ( ) Push one of the female terminals on the end of a large bare wire into each of the six holes in an extender terminal housing. Push each terminal until it locks in place.

( ) ( ) ( ) Cut the free ends of the six bare wires, if necessary, until their ends are even.

( ) ( ) ( ) Solder the free ends of the bare wires to the six terminals on a chassis connector.

( ) ( ) ( ) Check the extender assembly. All connections should be soldered. Also, make sure the bare wires do not touch each other.

( ) Set the three extender assemblies aside, they will be used during "Calibrator Adjustment."

( ) Set the front panel controls and switches as follows:

AF GAIN ..... Off.

RF GAIN ..... Fully clockwise.

MODE ..... LSB.

FUNCTION ..... WIDE.

BAND ..... 80.

PRESELECTOR ..... 12 o'clock position.

Refer to Figure 2-4 (in the "Illustration Booklet") for the following steps.

( ) Set control R306, on the VFO circuit board, to the center of its rotation.

( ) Set the tab on control R7 on the rear of the S-meter to the 3 o'clock position as shown on Figure 2-4.

( ) Connect a speaker to the SPKR jack on the rear panel, if not already done.

HFO COIL ADJUSTMENT

NOTE: You will adjust the heterodyne frequency oscillator (HFO) coils in the following steps. Refer to Figure 2-5 for the methods of inserting the alignment tool into the coil and making a "flag" out of tape for the alignment tool so you can count the turns of the tool. Rotate the tool until the voltage peaks on the meter scale. Then rotate the tool as shown in the HFO alignment chart.

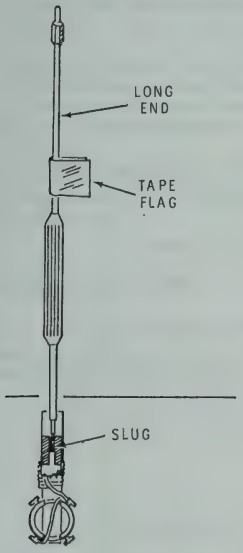


Figure 2-5

( ) Remove the gray wire from PCB pin C, on the VFO circuit board, and connect it to PCB pin D.

( ) Remove the white-black wire from PCB pin A. Leave this wire unhooked.

( ) Connect one end of the 12" jumper wire, that you prepared earlier, to PCB pin A. Connect the other end of the jumper wire to T.P. on the HFO/XTAL calibrator circuit board.

( ) Connect the line cord to an AC outlet.

( ) Turn the Receiver on with the AF GAIN control.

NOTE: Refer to the HFO/XTAL Calibrator Circuit Board Troubleshooting Chart on Page 86 if you experience any problems during the following adjustments.

( ) Adjust each HFO coil as described in the following chart. Before you adjust each coil for the peak meter indication, turn the slug counterclockwise two full turns. Then rotate the slug **clockwise** for maximum meter indication.

NOTE: Rotate control R7, on the rear of the meter, as necessary to keep the S-meter needle on scale.

BAND SWITCH	COIL NUMBER	ROTATE SLUG FOR PEAK INDICATION. THEN ROTATE SLUG AS DESCRIBED.
80	L406	1/2 turn CW*
40	L405	1/4 turn CW
20	L404	1/4 turn CW
15	L403	1/4 turn CW
10A	L402	1/4 turn CW
10B	L401	1/4 turn CW
		*clockwise

( ) Turn the Receiver off.

( ) Disconnect the line cord from the AC outlet.

( ) Disconnect the jumper wire from PCB pin A on the VFO circuit board and T.P. on the HFO/XTAL calibrator circuit board.

( ) Reconnect the white-black wire to PCB pin A.

( ) Remove the gray wire from PCB pin D and reconnect it to PCB pin C.

VFO ALIGNMENT

NOTE: Refer to the VFO Circuit Board Troubleshooting Chart on Page 86 if you experience any problems during the following adjustments.

( ) Set the front panel controls and switches as follows:

AF GAIN ..... Off.

RF GAIN ..... Fully clockwise.

MODE ..... LSB.

FUNCTION ..... WIDE. CAL

BAND ..... 15.

PRESELECTOR ..... 12 o'clock position.

( ) Refer to the inset drawing on Figure 2-4 and turn the screw in each VFO trimmer down snug. DO NOT FORCE. Then loosen each screw 1/3 turn.

( ) Connect the line cord to an AC outlet.

( ) Turn the MAIN TUNING knob clockwise until the dial stops rotating.

( ) Manually turn the square dial drive plate, located between the VFO assembly and the front panel, clockwise until the STOP mark near 500 aligns with the pointer.

( ) Turn the main tuning knob counterclockwise until the dial reads 200.

( ) Turn the Receiver on.

( ) Rotate R306, on the VFO circuit board, until the S-meter indicates zero (0).

( ) Turn the AF GAIN control knob clockwise until you hear noise from the speaker.

( ) Insert the alignment tool into the slug in coil L301 on the VFO circuit board.

NOTE: When you adjust the coil in the following step, you should be able to find the tone within 2 turns either way from its present setting.

( ) Turn the alignment tool very slowly until you hear a tone.

( ) Turn the BAND switch to 80.

( ) Turn the MAIN TUNING knob counterclockwise until the dial reads 0.

( ) Peak the PRESELECTOR on noise.

( ) Slide the FUNCTION switch to CAL (calibrator).

NOTE: When you perform the following adjustments, always use the strongest calibrator signal, if you find more than one.

( ) If necessary, turn the MAIN TUNING knob one or two dial divisions to either side of zero until you hear the calibrator signal. Note whether the signal occurred higher or lower in frequency than the zero mark on the dial.

( ) Return the dial to 0.

NOTES:

1. Several of the alignment steps call for adjusting your Receiver to obtain a zero-beat. To do this, slowly make the required adjustment in one direction and listen for a decrease in pitch and volume of the tone. If the pitch and volume seem to increase, make the adjustment in the opposite direction. The tone will go lower and lower in frequency and either disappear or become only an intermittent growl. This is zero-beat.

2. Perform **one** of the next two steps. If one trimmer does not provide enough range, adjust both trimmers in the same direction. Refer to the inset drawing for the location on the access holes on the bottom of the chassis.

( ) If the calibrate signal was **lower** in frequency, carefully adjust either VFO trimmer (through the access hole in the chassis bottom) **counterclockwise** until you hear the calibrator signal. Adjust the trimmer for zero beat. L301

( ) If the calibrate signal was **higher** in frequency, carefully adjust either VFO trimmer (through the access hole in the chassis bottom) **clockwise** until you hear the calibrator signal. Adjust the trimmer for zero beat. L301 CCW

( ) Turn the MAIN TUNING knob until the dial reads 500.

( ) Repeak the PRESELECTOR.

( ) Adjust coil L301 slightly for zero beat.

( ) Return the dial to 0.

( ) Adjust either VFO trimmer for zero beat.

( ) Repeat the preceding five steps as many times as necessary until zero beat occurs at 0 and 500 on the dial. Be sure the **last** adjustment you make is to a VFO trimmer. NOTE: You may have to repeat these adjustments several times.

( ) Turn the Receiver off.

( ) Disconnect the line cord from the AC outlet.

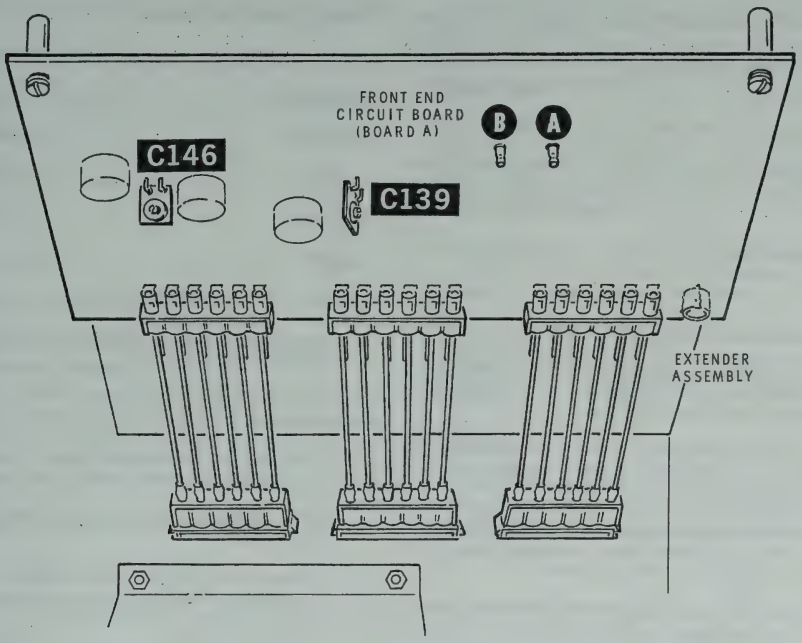


Figure 2-6

FRONT END ALIGNMENT

NOTE: Refer to the Front End Circuit Board Troubleshooting Chart on Page 86 if you experience any problems during the following adjustments. .

IF Bandpass Adjustment

NOTE: You may notice some improvement in overall gain if you use an RF generator and an AC voltmeter (in place of the calibrator signal and S meter) in the following steps.

Refer to Figure 2-6 for the following steps.

( ) Unplug the two gray wires from PCB pin A and B on the front end circuit board.

( ) Remove the two screws that hold the front end circuit board (board A) in place. Then remove the circuit board.

( ) Push an extender assembly onto the three chassis connectors where the front end circuit board was plugged in. Then push the circuit board onto the extender assembly.

( ) Set the front panel controls and switches as follows:

AF GAIN .....Off.

RF GAIN .....Fully clockwise.

MODE .....CW.

FUNCTION .....CAL.

BAND .....15.

TUNING DIAL .....300.

( ) Connect the line cord to an AC outlet.

( ) Turn the Receiver on.

( ) Turn the MAIN TUNING knob one or two dial divisions each way and locate the strongest nearby calibrator signal, if there is more than one.

( ) Adjust trimmer capacitors C139 and C146 for maximum S-meter indication. These trimmers may have only a little effect.

( ) Adjust control R7 on the rear of the S meter for mid-scale indication. If you cannot obtain a mid-scale indication, set the control for a maximum indication.

( ) Tune to the calibrator signal near 500 and adjust C139 for maximum meter indication.

( ) Tune to the calibrator signal near 0 and adjust C146 for maximum meter indication.

( ) Repeat the previous two adjustments several times for maximum meter indication at each end of the band.

( ) Turn the Receiver off.

( ) Disconnect the line cord from the AC outlet.

( ) Remove the front end circuit board from the Receiver.

( ) Unplug the extender assemblies from the circuit board. Then replace the circuit board in its compartment. Secure the circuit board with two 6-32 × 3/8" screws and two #6 lockwashers.

( ) Refer to Pictorial 5-11 (in the "Illustration Booklet") and push the connector on the end of the gray wire coming from lug 2 of C1A/C1B onto the PCB pin A on the front end circuit board. Position this wire exactly as shown in the Pictorial.

Push the connector on the end of the gray wire coming from lug 1 of C1A/C1B onto PCB pin B on the front end circuit board. Position this wire exactly as shown in the Pictorial.

RF Amplifier Adjustments

( ) Set the front panel controls and switches as follows:

AF GAIN ..... Off.

RF GAIN ..... Fully clockwise.

MODE ..... CW.

FUNCTION ..... CAL.

BAND ..... 80.

( ) Connect the line cord to an AC outlet.

( ) Turn the Receiver on and adjust the AF GAIN control to a comfortable listening level.

NOTE: When you align the front end circuit board, use the following procedure:

1. Turn the BAND switch to the position indicated in the following Alignment Chart.
2. Tune the Receiver to the calibrator signal near 200 on the dial.
3. Adjust the PRESELECTOR for maximum S-meter indication. Use the RF GAIN control to keep the S-meter indicator near mid-scale.
4. Adjust the indicated trimmer on the front end circuit board for maximum S-meter indication. Some of these trimmers may have only a little effect.
5. Repeat 3 and 4 until no further improvement is noticed.

Refer to Figure 2-4 (in the "Illustration Booklet") for the location of the trimmers in the following steps.

BAND SWITCH	APPROXIMATE PRESELECTOR POSITION	ADJUST TRIMMER
( ) 80 3.5	12 o'clock	C119 and C155
( ) 40 7	1 o'clock	C123
( ) 20 14	10 o'clock	C126
( ) 15 21	2 o'clock	C128
( ) 10B 28.5	2 o'clock	C131

( ) Turn the Receiver off.

S METER ADJUSTMENT

( ) Set the front panel controls and switches as follows:

AF GAIN ..... Off.

RF GAIN ..... Fully Clockwise.

MODE ..... CW.

FUNCTION ..... CAL.

BAND ..... 80.

TUNING DIAL ..... 300.

( ) Turn the Receiver on.

( ) Turn the MAIN TUNING knob and the PRESELECTOR for maximum indication of the S meter.

( ) Adjust control R7 (on the rear of the S meter) for an indication of about 40 on the S meter.

( ) Turn the Receiver off.

( ) Disconnect the line cord from the AC outlet.

CALIBRATOR ADJUSTMENT

NOTE: The calibrator should now be reasonably close to the correct setting. If you desire to have the calibrator set more accurately, perform one of the following adjustments. They are listed in order of preference.

Refer to Figure 2-7 for the following steps.

NOTE: Refer to the HFO/XTAL Calibrator Circuit Board Troubleshooting Chart on Page 86 if you experience any problems with the following adjustment.

( ) Remove the two screws that hold the HFO/XTAL calibrator circuit board in place. Then remove the circuit board.

( ) Push an extender assembly onto the two chassis connectors where the HFO/XTAL circuit board was plugged in. Then push the circuit board onto the extender assembly.

Method #1

( ) Connect an accurate frequency counter through a 500 pF capacitor to the collector of transistor Q404 on the HFO/XTAL calibrator circuit board.

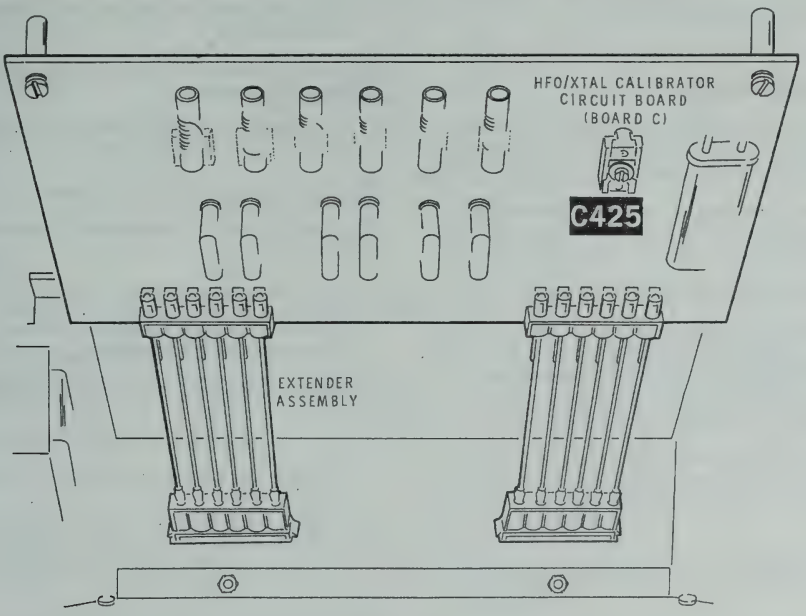


Figure 2-7

( ) Connect the line cord to an AC outlet.

( ) Turn the Receiver on.

( ) Adjust trimmer capacitor C425 until the frequency counter indicates 100 kHz.

( ) Turn the Receiver off and disconnect the frequency counter.

( ) Disconnect the line cord from the AC outlet.

( ) Remove the HFO/XTAL calibrator circuit board from the Receiver.

( ) Unplug the extender assemblies from the circuit board. Then replace the HFO/XTAL calibrator board in its compartment. Secure the circuit board with two 6-32 × 3/8" screws and two #6 lockwashers.

This completes the "Alignment." Proceed to "Cabinet Assembly."

Method #2

( ) Connect an antenna (suitable for the 40-meter band) to the ANT jack on the rear panel.

( ) Turn the BAND switch to 40.

( ) Connect the line cord to an AC outlet.

( ) Turn the Receiver on and tune to station CHU, Canada, on 7335 kHz. Note whether the station is higher or lower than 7335 kHz on your dial.

( ) Turn the main tuning knob until the dial reads 7335 kHz. Then hold the ZERO SET button in and tune to zero beat CHU.

( ) Turn the main tuning knob until the dial reads 7300 kHz.

( ) Adjust trimmer capacitor C425 for zero beat.

( ) Turn the Receiver off.

( ) Disconnect the line cord from the AC outlet.

( ) Remove the HFO/XTAL calibrator circuit board from the Receiver.

( ) Unplug the extender assemblies from the circuit board. Then replace the HFO/XTAL calibrator board in its compartment. Secure the circuit board with two 6-32 × 3/8" screws and two #6 lockwashers.

This completes the "Alignment." Proceed to "Cabinet Assembly."

Method #3

NOTE: This method requires the use of a separate SWL receiver that can receive station WWV, Colorado, on 15,000 kHz or 10,000 kHz.

( ) Tune your SWL receiver to zero beat WWV on either 15,000 kHz or 10,000 kHz.

( ) Connect the antenna input on your SWL receiver to the ANT socket on the rear panel of your HR-1680.

( ) Connect the line cord to an AC outlet.

( ) Turn your HR-1680 on and place the FUNCTION switch in the CAL position.

( ) Adjust trimmer capacitor C425 for zero beat with WWV in your SWL receiver.

( ) Turn both receivers off and disconnect the wire that connects the antenna inputs together.

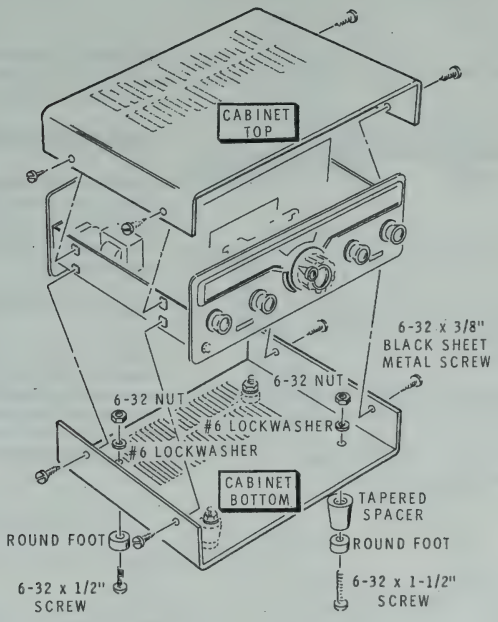
( ) Disconnect the line cord from the AC outlet.

( ) Remove the HFO/XTAL calibrator circuit board from the Receiver.

( ) Unplug the extender assemblies from the circuit board. Then replace the HFO/XTAL calibrator board in its compartment. Secure the circuit board with two 6-32 x 3/8" screws and two #6 lockwashers.

This completes the "Alignment." Proceed to "Cabinet Assembly."

CABINET ASSEMBLY



PICTORIAL 6-1

NOTE: The cabinet top and cabinet bottom are identical except that four holes are provided in the cabinet bottom for attaching the feet.

Refer to Pictorial 6-1 for the following steps.

NOTE: Perform only one of the following two steps.

1. ( ) If you wish to have your Receiver cabinet sit level, install a round foot at each corner of the cabinet bottom. Use 6-32 x 1/2" hardware.

NOTE: When you perform the next step, be sure you mount the tapered spacers and the round feet in the holes **away** from the ventilation slots in the cabinet bottom.

2. ( ) If you wish to have the front panel tilted upward, install a round foot on each rear corner with 6-32 x 1/2" hardware. Install a tapered spacer and a round foot at each front corner with 6-32 x 1-1/2" hardware.

( ) Place the chassis into the cabinet bottom and secure it with two 6-32 x 3/8" black sheet metal screws on each side. Position the ventilating slots **away** from the front panel.

( ) Similarly, place the cabinet top onto the chassis and secure it with two 6-32 x 3/8" black sheet metal screws in each side.

This completes the assembly of your Receiver. Proceed to the "Installation" section.

INSTALLATION

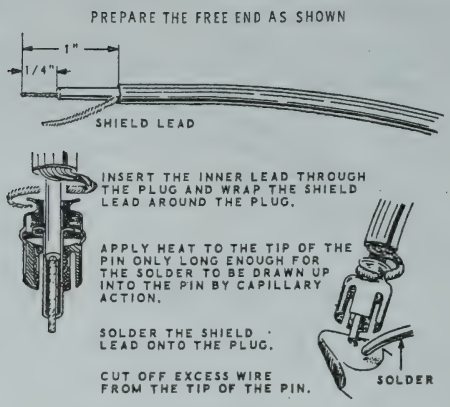


Figure 3-1

This section of the Manual gives you examples of how to connect the Receiver for use by itself or for use with a transmitter for station operation.

BASIC CONNECTIONS

To connect the Receiver for use by itself, simply connect a 4 or 8-ohm speaker to the SPKR jack and a suitable antenna to the ANT jack on the rear panel. Figure 3-1 shows how to install phono connectors (supplied) on the ends of your speaker and antenna cables.

STATION CONNECTIONS

Figure 3-2 shows an example of connections for use with a transmitter. The sidetone input signal from the transmitter, if used, must be at least 10 millivolts rms or greater and should be between 300 and 3300 Hz. The mute input should switch between open (for receive) and ground (for transmit). Refer to the ARRL Handbook for typical relay hookups.

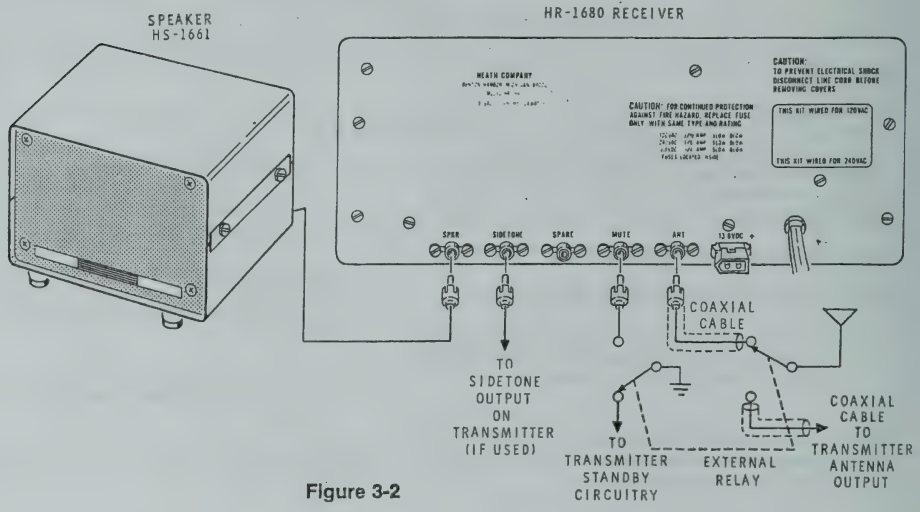


Figure 3-2

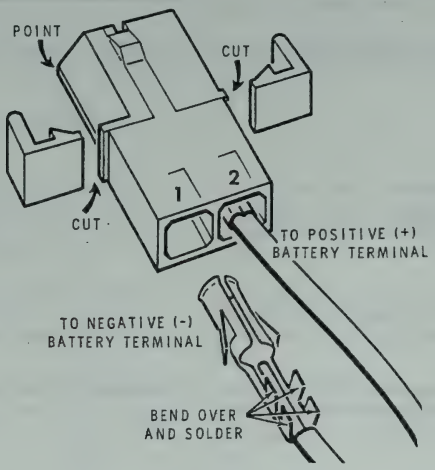


Figure 3-3

BATTERY CONNECTION

If you wish to operate your Receiver from a battery, refer to Figure 3-3 and perform the following steps.

NOTE: The battery must be capable of supplying 13.8 volts at 3/4 amperes.

( ) Cut the ears from the male terminal housing.

( ) Temporarily disconnect the supply wires from your battery.

( ) Solder a female terminal onto the ends of each wire coming from your battery.

( ) Position the male terminal housing with the point toward your left as shown. Then push the terminal on your negative (−) battery wire into hole 1 of the housing until it locks in place.

( ) Similarly, push the terminal on your positive (+) battery wire into hole 2 of the housing until it locks.

( ) Push the male terminal housing into the female housing on the rear panel of the Receiver.

NOTES:

1. When you use the Receiver on AC, disconnect the battery to prevent the battery from being discharged.

2. Use a hash filter in the supply wires when you use this Receiver in a mobile installation. Refer to the ARRL Handbook for noise reduction techniques.

This completes the "Installation." Proceed to the "Operation" section.

OPERATION

Refer to Figure 4-1 (in the "Illustration Booklet") for the location of the front panel controls and switches referred to in the following paragraphs.

TUNING DIAL

The tuning dial is calibrated in divisions from 0 to 500. Each division represents 5 kHz. The dial reading (in kHz) is added to the BAND switch setting (in MHz) to determine the frequency to which the Receiver is tuned. For example:

BAND switch	40 (7 MHz)
Dial reading	35 kHz
Frequency	7.035 MHz

ZERO SET

Pushing this button while turning the MAIN TUNING knob locks the dial scale while the VFO frequency is being changed. This permits the tuning dial to be calibrated at 100 kHz intervals.

AF GAIN

Turns the power on and increases the volume of the received signal with clockwise rotation.

RF GAIN

Clockwise rotation increases the Receiver sensitivity. This control is usually positioned fully clockwise. Turn the control counterclockwise to reduce sensitivity when exceptionally strong signals are being received, or to reduce adjacent channel interference.

BAND

Selects the desired amateur band in meters. The Band switch markings on the front panel correspond to the following frequencies in MHz when the tuning dial is set to zero (0):

80	3.5
40	7
20	14
15	21
10A	28
10B	28.5

PRESELECTOR

Tunes the RF amplifier stages. Readjust this control for maximum signal on each BAND as the main tuning is changed.

PHONE

Connect low impedance headphones (or high sensitivity, high impedance headphones) through a phone plug. When you insert a plug in this jack, the loudspeaker is automatically disconnected.

NOTE: If you use low impedance headphones, you may notice a hum at low volume levels. Add a 100 Ω resistor (not supplied) in series with your headphones to reduce this hum.

MODE

Place this switch in the appropriate position for lower sideband, upper sideband, or CW reception. This switch also selects a slow AGC time constant in the sideband positions and a fast AGC time constant in the CW position.

FUNCTION

Place this switch in the desired bandpass position (either narrow or wide). Place the switch in the calibrate position to turn on the 100 kHz crystal calibrator for dial calibration.

TYPICAL OPERATING CHARACTERISTICS

The following conditions are normal and you should not consider them as malfunctions.

1. The S meter may show two peak indications on strong signals. This is due to the audio-derived AGC circuit. One peak is considerably lower than the desired peak. Tune for the greatest peak on the meter.

2. The Receiver may have a different pitch (tone) at high volume levels when the Function switch is in the narrow position. This is due to the narrower bandpass and is normal.

3. When you are calibrating the Receiver dial, there may be several weak calibrator signals. Always use the strongest calibrator signal.

4. If you cannot peak the Preselector on both ends of the 80-meter band, adjust trimmer C155 on the front end circuit board until you are able to.

5. You may notice a hum when you use low impedance headphones. Connect a 100 Ω resistor (not supplied) in series with your headphones to reduce this hum.

6. The heat sink on transistor Q201, on the AUD/REG circuit board, becomes quite hot to the touch. Use caution when you have your hands near this area.

IN CASE OF DIFFICULTY

Begin your search for any trouble that occurs after assembly by carefully following the steps listed below in the "Visual Checks." After you complete the "Visual Checks," refer to the Troubleshooting Charts.

NOTE: Refer to the "Circuit Board X-Ray Views" on Page 94 for the physical location of parts on the circuit boards.

VISUAL CHECKS

1. Recheck the wiring. Trace each lead with a colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something that you have consistently overlooked.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes" on Page 14. Be sure there are no solder "bridges" between circuit board foils.

3. Check to be sure all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Make sure each diode band is positioned above the band printed on the circuit board.

4. Check electrolytic capacitors to be sure their positive (+) mark is at the correct position.

5. Check to be sure each IC is properly installed in its socket, and the pins are not bent out or under the IC. Also be sure the IC's are installed in their correct positions.

6. Check the values of the parts. Be sure in each step that you wired the correct part into the circuit, as shown in the Pictorial. It would be easy, for example, to install a 68 kΩ (blue-gray-orange) resistor where a 6800 Ω (blue-gray-red) resistor should be installed.

7. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

8. A review of the "Circuit Description" may also help you determine where the trouble is.

If you still have not located the trouble after the "Visual Checks" are complete, and a voltmeter is available, check voltage readings against those shown on the Schematic. Read the "Precautions for Troubleshooting" before you make any measurements. NOTE: All voltage readings were taken with a high impedance voltmeter. Voltages may vary as much as ±20%.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

PRECAUTIONS FOR TROUBLESHOOTING

1. Use caution when you test IC and transistor circuits. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than other circuit components.

2. Be sure you do not short any terminals to ground when you make voltage measurements. If the probe should slip, for example, and short across terminals or voltage sources, it is very likely to cause damage to one or more IC's, transistors, or diodes.

CHECKING TRANSISTORS AND DIODES

SILICON BIPOLAR TRANSISTORS

To check a transistor accurately, you should use a transistor tester. However, if one is not available, you can use an ohmmeter to determine the general condition of any one of the bipolar transistors in this kit. The ohmmeter you use must have at least 1 volt DC at the probe tips to exceed the threshold of the diode junctions in the transistor you are testing. Most vacuum tube voltmeters meet this requirement.

To check a transistor with an ohmmeter, proceed as follows:

1. Remove the transistor from the circuit.

2. Set the ohmmeter to the R X 100 range.

3. Connect one of the ohmmeter test leads to the base (B) of the transistor. Touch the other meter lead to the emitter (E) and then to the collector (C). Both readings should be the same, but may be either high or low. If one reading is high and the other low, the transistor should be replaced. (Use the Identification Chart on Page 98 to identify the transistor leads).

4. Interchange the test leads and repeat step 3.

NOTE: In the unusual case when the readings are all low, or all high, no matter which ohmmeter lead is connected to the base, the transistor should be replaced.

MOSFETS

Insulated gate type MOSFETs are used at Q101, Q102, and Q103 on the front end circuit board and at Q205 on the AUD/REG circuit board. Usually, any defect in these devices is an internal short circuit between the source and one of the gates. You can check them in the circuit with a high impedance voltmeter (10 megohms or higher). An abnormally low source voltage may indicate an internal short circuit.

DIODES

To check a diode, unsolder one end from the circuit board, pull the lead up and out of the circuit board hole, and proceed as follows:

1. Set the ohmmeter to the R X 1000 range.

2. Connect one of the ohmmeter test leads to the lead at the cathode (banded) end of the diode. Connect the other test lead to the other diode lead. Note the meter reading. Then interchange the meter leads and take another reading. One reading should be high and the other low (at least 10:1). If both readings are either high or low, the diode should be replaced.

TROUBLESHOOTING CHARTS

The following charts list the "Problem" and the "Possible Cause" of a large number of malfunctions. If a particular part or parts are mentioned (transistor Q201, for example, or switch SW2) as a possible cause, check these parts to see if they are wired or installed incorrectly. Also check to see if an improper part was installed at that location. It is also possible, on rare occasions, for a part to be faulty.

GENERAL

PROBLEM	POSSIBLE CAUSE
Dial lamps don't light.	1. Fuses F1 and F201. 2. Switch SW1 defective or wired wrong. 3. Lamps PL1 and PL2 open or shorted. 4. Check wiring of red wires on chassis. 5. See AUD/REG Circuit Board Troubleshooting Chart.
No audio output.	1. Speaker or connections. 2. Wiring error on jack J3, control R4, or switch SW2. 3. Defective shielded cable.
No IF output.	1. Cable wiring error on chassis. 2. See AUD/REG Circuit Board Troubleshooting Chart.
No output from first mixer (Q102).	1. Cable wiring error at terminal C6 or A13, or defective cable. 2. HFO aligned incorrectly. 3. See HFO/XTAL Circuit Board Troubleshooting Chart.
No output from second mixer (Q103).	1. Cable wiring error at terminal B1 or B16, or defective cable. 2. See VFO Circuit Board Troubleshooting Chart.
No RF amplifier output.	1. Wiring error on switch SW4. 2. Wiring error on control R1 or defective control. 3. See Front End Circuit Board Troubleshooting Chart.
AGC does not operate.	1. Wiring error on switch SW3. 2. See AUD/REG Circuit Board Troubleshooting Chart.
BFO does not operate.	1. Wiring error on switch SW3 or at terminals D14 or D15. 2. See AUD/REG Circuit Board Troubleshooting Chart.
Calibrator does not operate.	1. Wiring error on switch SW2 or terminal C3. 2. See HFO/XTAL Calibrator Circuit Board Trouble-shooting Chart.
No sidetone from transmitter.	1. Wiring error on socket BD (J5) or terminal D9.
No muting or continuous muting.	1. Wiring error on socket BF (J2) or terminal D3. 2. See VFO Circuit Board, Front End Circuit Board, and AUD/REG Circuit Board Troubleshooting Charts.
No voltage from 23 VDC power supply.	1. Diodes D1 through D4 installed wrong or defective. 2. Capacitor C2 defective. 3. Wiring error on terminal strip CB or CC. 4. Fuse F1 open. 5. Wiring error on switch SW1 or defective switch. 6. AC source.
Will not operate from a 13.5 volt battery.	1. Wiring error on switch SW1 or connector BH (P1). 2. Fuse F201 open.

FRONT END CIRCUIT BOARD

PROBLEM	POSSIBLE CAUSE
Weak or no output from RF amplifier.	1. Diodes D101 through D118 installed wrong or defective. 2. Coils L106 through L109 installed wrong. 3. Front end alignment. 4. Transistor Q101 installed wrong or defective. 5. Wiring error on control R1 or defective control. 6. Transistor Q104 installed wrong or defective. 7. Capacitor C1A or C1B open or shorted.
No output from first mixer (Q102).	1. No HFO signal (see HFO/XTAL Calibrator Circuit Board Troubleshooting Chart). 2. Transistor Q102 installed wrong or defective. 3. Wrong part installed at C138, C139, C141 through C147, and L116 through L118.
No output from second mixer (Q103).	1. Wrong part at L119. 2. Capacitor C153 or C154. 3. Transistor Q103 installed wrong or defective. 4. No VFO signal (see VFO Circuit Board Troubleshooting Chart).

VFO CIRCUIT BOARD

PROBLEM	POSSIBLE CAUSE
No VFO output.	1. Transistors Q301 through Q304 installed wrong or defective. 2. Coil L301 installed wrong. 3. Wrong part at C301 through C307. 4. Wire from hole E to VFO capacitor C3 not connected or shorted to mounting bracket.
S meter does not operate.	1. Wrong part at R305 and R306. 2. Wiring error between meter and VFO circuit board. 3. Meter M1 defective. 4. See AUD/REG Circuit Board Troubleshooting Chart. 5. Diode D5 defective. 6. Controls R306 or R7 incorrectly set or defective.

HFO/XTAL CALIBRATOR CIRCUIT BOARD

PROBLEM	POSSIBLE CAUSE
No HFO signal.	1. Diodes D401 through D406, D408, D409, and D411 through D414 installed wrong or defective. 2. Wrong parts installed at capacitor locations C402, C406, C408, C412, C415, or C418. 3. Wrong parts installed at L401 through L406. 4. Wrong parts installed at Y401 through Y406 or defective crystal. 5. Transistors Q401 and Q402 installed wrong or defective. 6. Wiring error on switch SW4.
Calibrator does not operate.	1. Wiring error on switch SW2. 2. Transistors Q403 and Q404 installed wrong or defective. 3. Crystal Y407 defective. 4. Diode ZD401 installed wrong or defective.

AUD/REG CIRCUIT BOARD

PROBLEM	POSSIBLE CAUSE
No audio output.	1. IC202 and IC203 installed wrong or defective. 2. BFO not operating (see next problem).
BFO does not operate.	1. Transistors Q206, Q208, and Q209 installed wrong or defective. 2. Crystal Y205 or Y206 defective. 3. See General Troubleshooting Chart.
Product detector does not operate.	1. IC204 installed wrong or defective. 2. BFO not operating (see above problem). 3. No IF signal (see next problem).
No IF output.	1. Transistors Q205 and Q207 installed wrong or defective. 2. Wrong part at C235, C237, L201, or L202. 3. Wrong parts or defective at Y201 through Y204, C254, and C256. 4. Incorrect AGC voltage (see problem below). 5. Transistor Q202 defective. 6. Coil TC201 defective.
S meter does not operate.	1. Transistor Q204 installed wrong or defective. 2. Diodes D205 and D206 installed wrong or defective. 3. See VFO Circuit Board Troubleshooting Chart.
Incorrect AGC voltage.	1. Transistor Q203 installed wrong or defective. 2. Diode ZD202 defective. 3. Receiver muted (see muting problem in General Troubleshooting Chart). 4. Diode D207 defective. 5. Transistor Q101 (on front end circuit board) or Q205 defective. 6. See S-meter problem above.
Incorrect or no 13.5-volt supply.	1. IC201 defective. 2. Capacitor C202 defective. 3. Fuse F201 defective. 4. Transistor Q201 defective. 5. Wrong part at R201 and R202. 6. See General Troubleshooting Chart.

SPECIFICATIONS

Frequency Coverage (Megahertz)	3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 21.0 to 21.5, 28.0 to 28.5, 28.5 to 29.0.
Sensitivity	Less than 0.5 microvolts for 10 dB signal-plus-noise to noise ratio for SSB operation.
IF Selectivity	2.1 kHz minimum at 6 dB down, 7 kHz maximum at 60 dB down.
Overall Audio Response	
Wide	2100 Hz minimum at 6 dB down, 7 kHz maximum at 60 dB down.
Narrow	250 Hz minimum at 6 dB down, 2.5 kHz maximum at 60 dB down (center frequency approximately 750 Hz).
Overall Gain	Less than 1.5 microvolt input for 0.25 watts of audio output.
Audio Output Power	.8 watts into a 4-ohm load continuous (1.2 watts peak power) at less than 10% THD.
Dynamic Range	120 dB or greater.
AGC Characteristic	
Blocking Level	3 volts.
Time Constant	Attack time less than 1 millisecond. Release time switch selectable at 100 microseconds (CW) or 1 second (SSB).
Intermodulation Distortion	−60 dB
Image Rejection	50 dB or better.
IF Rejection	60 dB or better.
Internally Generated Spurious Signals	Below 1 microvolt equivalent antenna input except at 3.74, 21.2, 28.6, and 28.9 MHz.
Mode of Operation	Selectable upper or lower sideband and CW.

Frequency Stability	Less than 100 Hz per hour drift after 30 minutes warm up. Less than 100 Hz drift for 10% change in line voltage.
Tuning Rate	Approximately 15 kHz per turn.
Dial Accuracy	Within 2 kHz after calibration at nearest 100 kHz marker.
Muting	Shorted external ground at Mute socket.
Sidetone Input Level	10 millivolts or greater (300 mV maximum).
Dial Backlash	50 Hz or less.
IF Frequencies	
First IF	8.395 to 8.895 MHz.
Second IF	3.395 MHz.
Antenna Input Impedance	50 Ω unbalanced.
Temperature Range	−10°C to 50°C.
Meter Calibration	0 to S-9 +60 dB.
Front Panel Controls	AF Gain control/Power on-off. Preselector. RF Gain. VFO tuning. Band switch. Function switch. Mode switch.
Power Requirements	120 or 240 volts AC (50/60 Hz) 27 watts maximum or 11.5 VDC to 15 VDC at 0.75 amperes maximum.
Overall Dimensions (with knobs and feet Installed)	12-3/4" wide × 6-3/4" high × 12" deep (32.39 cm × 17.15 cm × 30.48 cm).
Net Weight	9-3/4 lbs (4.42 kg).

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Block Diagram and the Schematic while you read this "Circuit Description." The part numbers on the Schematic are arranged in the following groups to help you locate specific parts on the Schematic, circuit boards, and chassis:

1-99	Parts mounted on the chassis.
100-199	Parts mounted on the front end circuit board.
200-299	Parts mounted on the AUD/REG circuit board.
300-399	Parts mounted on the VFO circuit board.
400-499	Parts mounted on the HFO/XTAL calibrator circuit board.

Incoming signals at the antenna are first amplified by transistor Q101 and then mixed in transistor Q102 with a signal from the HFO/XTAL Calibrator circuit board. The resulting 8.395 to 8.895 MHz first IF signal passes through an 8.5 MHz bandpass filter to transistor Q103. Q103 mixes the first IF signal with the VFO signal which produces a 3.395 MHz second IF signal. The second IF signal passes through a crystal filter to IF amplifier transistor Q205. The amplified IF signal is then changed to audio frequencies by IC204 which is a product detector. The detected audio signal is amplified in IC203C and, depending on the position of the Function switch, is coupled either directly to audio amplifier IC202 or through the active bandpass filter, IC203A and IC203B, to IC202. IC202 amplifies the audio enough to drive a speaker.

The following paragraphs describe the operation of each circuit in more detail.

FRONT END CIRCUIT BOARD

ANTENNA INPUT CIRCUIT

Signals from the antenna first pass through a 3.395 MHz trap, a high frequency trap, and an 8.5 MHz trap before they are coupled to the antenna tuning circuits. The 3.395 MHz trap (TC101) is a series tuned circuit that traps out the 3.395 MHz signal on the antenna input and improves the IF rejection of the Receiver. The high frequency trap (L102 and C103) is a parallel tuned circuit that traps out signals above 30 MHz. The 8.5 MHz trap (L103 through L105 and C105 through C107) is a series and parallel tuned circuit combination which operates in a manner similar to the 3.395 MHz trap.

After the signal passes through the three trap circuits, it is coupled through a tuned circuit to RF amplifier Q101. Each of the four tuned circuits (L106 through L109, C109, C112, and C1A) performs two functions. First, the circuit allows only the proper signals to pass through, as determined by the band to which you are tuned, and second, it matches the low impedance antenna circuit to the high impedance input of gate G1 of the RF amplifier. The tuned circuits are selected by the Band switch and switching diodes D101 through D108.

RF AMPLIFIER CIRCUIT

Signals from the antenna input circuit are coupled through C116 to gate G1 of RF amplifier Q101, where they are amplified. Tuned circuits (L111 through L115 and the associated capacitors) provide further signal selectivity. These tuned circuits are selected by the Band switch and switching diodes D114 through D118.

The gain of the RF amplifier is controlled by two methods. AGC voltage, from the AUD/REG circuit board, is applied to gate G2 of Q101 and a voltage from the RF Gain control is applied through R109 to the source (S) of Q101. As the AGC voltage goes down, the RF amplifier gain decreases. As the voltage from the RF Gain control goes up, Q101 becomes cut off. Q104 is used to cut off Q101 during muting when the Receiver is used with a transmitter.

FIRST MIXER CIRCUIT

Signals from the RF amplifier are coupled through C133 to gate G1 of first mixer transistor Q102. At the same time, a signal from the HFO (heterodyne frequency oscillator) circuit board is coupled through C134 to gate G2 of Q102. Q102 mixes these two signals and produces sum and difference frequencies at its drain (D). The bandpass filter (L116 through L118 and the associated capacitors) allows only the 8.395 to 8.895 MHz first IF signal to pass through to the second mixer.

SECOND MIXER CIRCUIT

The first IF signal from the bandpass filter is coupled through C147 to gate G1 of second mixer transistor Q103. At the same time, a signal from the VFO (variable frequency oscillator) circuit board is coupled through C149 to gate G2 of Q103. Q103 mixes these two signals and produces sum and difference frequencies at its drain (D). A tuned circuit (L119, C153, and C154) provides a low impedance for the 3.395 MHz second IF signal which now goes to the AUD/REG circuit board.

AUD/REG CIRCUIT BOARD

CRYSTAL FILTER CIRCUIT

The 3.395 MHz second IF signal, which comes from the front end circuit board, is coupled through C246 to the base (B) of Q207. This transistor matches the impedance of the output of the front end circuit board to the impedance of the crystal filter circuit. The second IF signal from the collector (C) of Q207 is then coupled through C248 to the 2.1 kHz crystal filter (Y201 through Y204, TC201, C254, and C256). Because the crystal filter allows only the 3.395 MHz signal to pass, the sharp selectivity provided by the filter permits excellent rejection of unwanted adjacent signals.

IF AMPLIFIER CIRCUIT

The 3.395 MHz second IF signal, coming from the crystal filter circuit, is coupled through C239 to gate G1 of IF amplifier Q205. Power is supplied to the drain (D) of the transistor through a tuned circuit formed by L201 and C235. AGC voltage is applied to gate G2 of Q205 to limit the gain during strong signal reception.

BFO CIRCUIT

The BFO (beat frequency oscillator) is made up of two crystal controlled oscillators which are selected by the Mode switch. The LSB oscillator (Q208, Y205, and associated components) and the USB/CW oscillator (Q209, Y206, and associated components) are coupled through C243 and C244, respectively, to the base (B) of Q206. Q206 is an emitter follower stage which matches the high impedance output of the crystal oscillators to the low impedance input of the product detector.

PRODUCT DETECTOR

The amplified 3.395 MHz second IF signal is coupled through C231 to the signal input (pin 4) of product detector IC204. A signal from the BFO is coupled through C233 to the carrier input (pin 7) of IC204. IC204 mixes the two input signals and produces sum and difference signals at its output (pin 6). The sum frequency is filtered out by C224 and C225. The difference frequency is an audio signal. R229 sets the gain of the stage.

AUDIO CIRCUIT

The audio signal, coming from the product detector, is coupled through C224 and R218 to the inverting input (pin 13) of operational amplifier IC203C. The amplified audio signal (pin 14) is coupled either through C216 to the function switch or through R213 to the active filter stage. The active filter stage is formed by IC203A and IC203B. These cascaded operational amplifiers are bandpass tuned for a selected bandwidth of audio frequencies. The bandwidth of the active filter circuit is 300 Hz at a center frequency of 750 Hz. This active filter provides sharp selectivity and permits excellent rejection of unwanted adjacent audio signals in the CW mode. The output of the active filter stage is coupled through C215 to the Function switch.

Function switch (SW2) selects either wide bandpass audio signal, coming from IC203C, or the narrow bandpass audio signal, coming from IC203B, and passes it to the AF Gain control (R4). The audio signal, coming from the AF Gain control, and the sidetone input, coming from Sidetone jack J5 (when used), are then fed to the input (pin 7) of the audio power amplifier IC202. The amplified audio signal is then coupled through C205 to the Phone jack (J3) and the SPKR jack (J4). When headphones are connected to the Phone jack, the speaker is automatically disconnected.

S-METER AND AGC CIRCUIT

A sample of the audio signal, coming from the product detector (IC204), is coupled through C218 to operational amplifier IC203D. The amplified audio signal is then coupled through C221 to voltage doubling diodes D205 and D206. D205 and D206 rectify the positive half of the audio signal to produce a pulsating DC voltage.

The DC voltage is affected by a selectable-release time-constant circuit formed by C223 and either R5 or R6 on the Mode switch. The Mode switch selects either R5 or R6 to produce fast and slow AGC action.

The controlled DC voltage causes the source (S) of Q204, a DC voltage detector, to vary in proportion with the amount of voltage on its gate (G). Part of this varying voltage is sent to the S meter to indicate the strength of the received signal. Another part of this varying voltage is DC-coupled through resistor R234 to the base of AGC control transistor Q203. When there is no signal present, Q203 is turned off, allowing zener diode ZD201 to hold the AGC voltage to about 3 volts DC. When a signal is present, the voltage on the source of Q204 goes up, causing Q203 to turn on. The AGC voltage at its collector will drop to .2 volts DC. The AGC voltage controls the gain of IF amplifier Q205 and RF transistor Q101 (on the front end circuit board). This prevents the Receiver from overloading on strong incoming signals.

POWER SUPPLY CIRCUIT

DC voltage from the power supply mounted on the chassis is connected to the collector of series regulator pass transistor Q201. The output voltage on the emitter is controlled by the base bias provided by IC201. IC201 samples and compares the incoming DC voltage with the output voltage and adjusts Q201 as necessary to maintain a fixed DC voltage level. R201 and R202 control the regulated output voltage.

Fuse F201 is used for protection against short circuits during battery operation.

VFO CIRCUIT BOARD

A field effect transistor (Q301) is used in a Hartley oscillator circuit in the VFO. Part of coil L301, variable capacitor C3 (the main tuning capacitor), and fixed temperature compensating capacitors C301 through C307 are used in the frequency determining circuits. The remaining part of coil L301 is used for feedback to maintain oscillation. Zener diode ZD301 regulates the voltage at the drain of Q301.

The output of oscillator Q301 is coupled through C308 to source-follower transistor Q302, which acts as a buffer and impedance matching device. Transistor Q303 is a fixed-tuned amplifier which is followed by a low-pass filter (L302 through L305 and C314 through C318) to reduce the harmonic output of the VFO.

Transistor Q304 is used to turn off transistor Q303 during transmission, when the Receiver is used with a transmitter.

Control R306 is used to adjust the S meter to zero during no-signal conditions.

HFO/XTAL CALIBRATOR CIRCUIT BOARD

HFO CIRCUIT

This circuit is formed by a straight-forward crystal controlled oscillator. Switching diodes D401 through D406, D408, D409, and D411 through D414 and Band switch SW4 determine which crystal and its associated tuned circuit is connected to oscillator transistor Q401. The HFO signal produced by Q401 is coupled through C409 to the base of HFO amplifier transistor Q402. The amplified HFO signal is then coupled through C416 to the front end circuit board.

A detector circuit consisting of C419, C421, R419, and D415 provides a DC voltage at TP for use during HFO alignment.

CRYSTAL CALIBRATOR CIRCUIT

Transistors Q403 and Q404 form a 100 kHz astable multivibrator that is controlled by crystal Y407. The output of this multivibrator circuit is a square wave that produces harmonics at every 100 kHz on the dial. Resistor R427 and zener diode ZD401 reduce the 12-volt supply voltage to 5 volts for the multivibrator.

This circuit operates when the Function switch is in the Cal position.

OTHER CIRCUITS

MUTING CIRCUIT

The purpose of this circuit is to shut down the Receiver during transmit (when used with a transmitter) so no interfering or strong signals are present.

When Mute jack J2 is shorted during transmit, transisor Q104, on the front end circuit board, and Q202, on the AUD/REG circuit board, are turned on which turn off RF amplifier transistor Q101 and IF amplifier transistor Q205 respectively.

At the same time, Q304 on the VFO circuit board is turned off, which removes the supply voltage to buffer transistor Q303.

During receive, the opposite occurs allowing the receiver circuits to operate normally.

POWER SUPPLY CIRCUIT

AC power is supplied through fuse F1 and switch SW1A to the primary of transformer T1. T1 has dual primary windings to allow operation from either 120 or 240-volt line voltages.

The voltage at the secondary is rectified by a full-wave bridge circuit formed by diodes D1 through D4. The rectified DC voltage is then filtered by capacitor C2 and is then applied to the regulator circuit on the AUD/REG circuit board.

CIRCUIT BOARD X-RAY VIEWS

NOTE: To identify a part shown in one of these views, so you can order a replacement, proceed in either of the following ways:

1. A. Refer to the place where the part is installed in the Step-by-Step instructions and note the "description" of the part (for example: 22 kΩ, .05 μF, or MPF105).

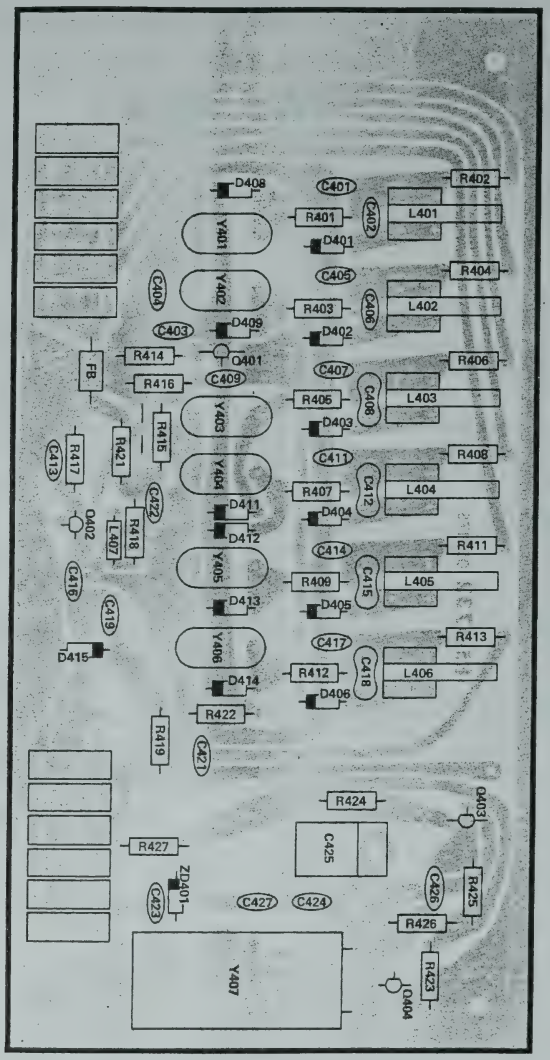
   B. Look up this description in the appropriate parts list.

2. A. Note the identification number of the part (R-number, C-number, etc.).

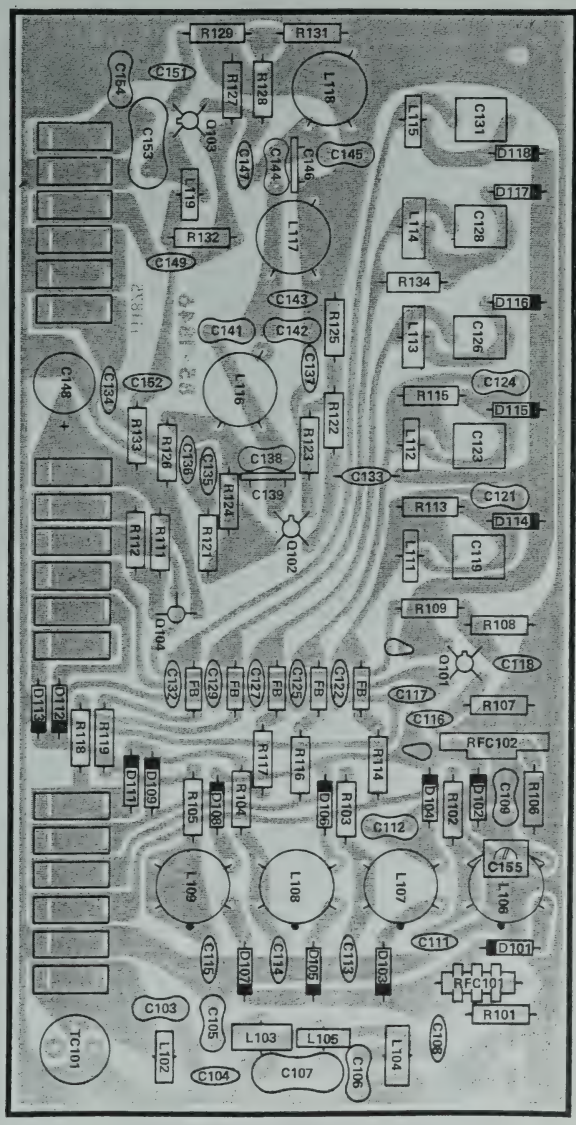
   B. Locate the same identification number (next to the part) on the Schematic. The "description" of the part will also appear near the part.

   C. Look up this description in the appropriate parts list.

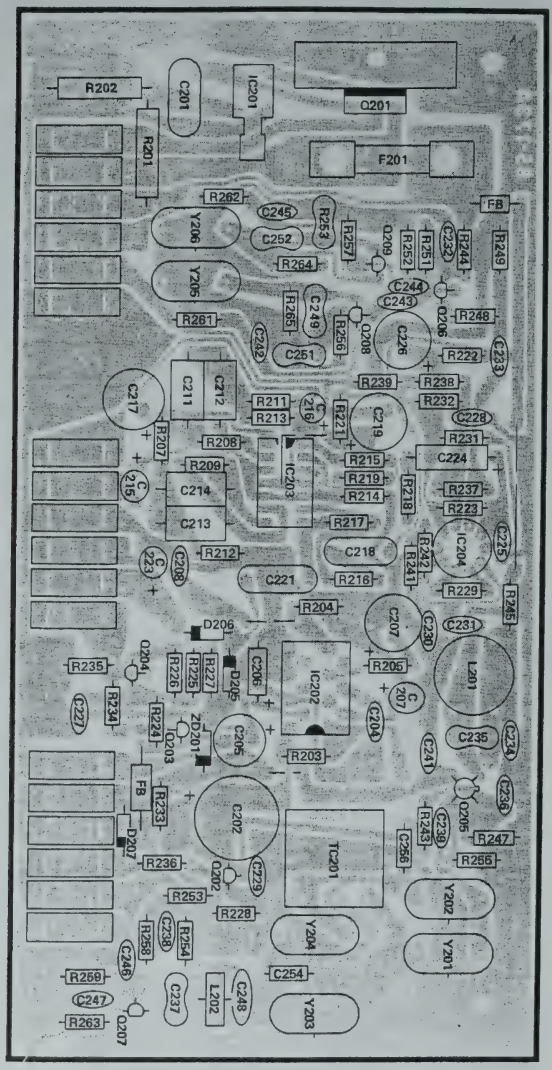
VFO CIRCUIT BOARD
(Shown from component side)



HFO/XTAL CALIBRATOR CIRCUIT BOARD
(Shown from component side)



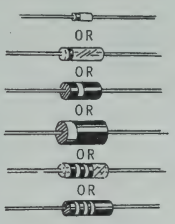
FRONT END CIRCUIT BOARD
(Shown from component side)



AUD/REG CIRCUIT BOARD
(Shown from component side)

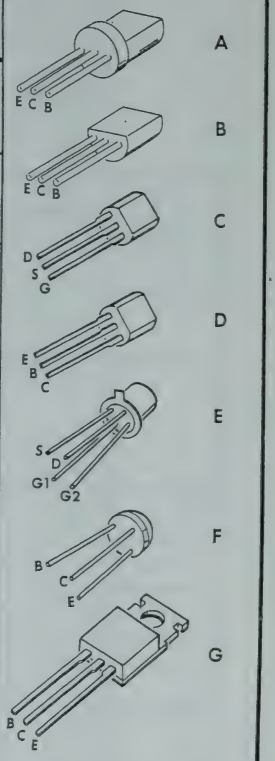
IDENTIFICATION CHARTS

DIODES

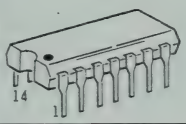
HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
56-16	1N751	ZD401	NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES 
56-19	VR-9.1	ZD301	
56-24	1N458	D101, D102, D103, D104, D105 D106, D107, D108, D109, D111 D112, D113, D114, D115, D116 D118, D401, D402, D403, D404 D405, D406, D408, D409, D411 D412, D413, D414	
56-26	1N191	D205, D206, D207, D415	
56-50	DO-7	ZD201	
56-89	GD510	D5, D302	
57-65	1N4002	D1, D2, D3, D4,	

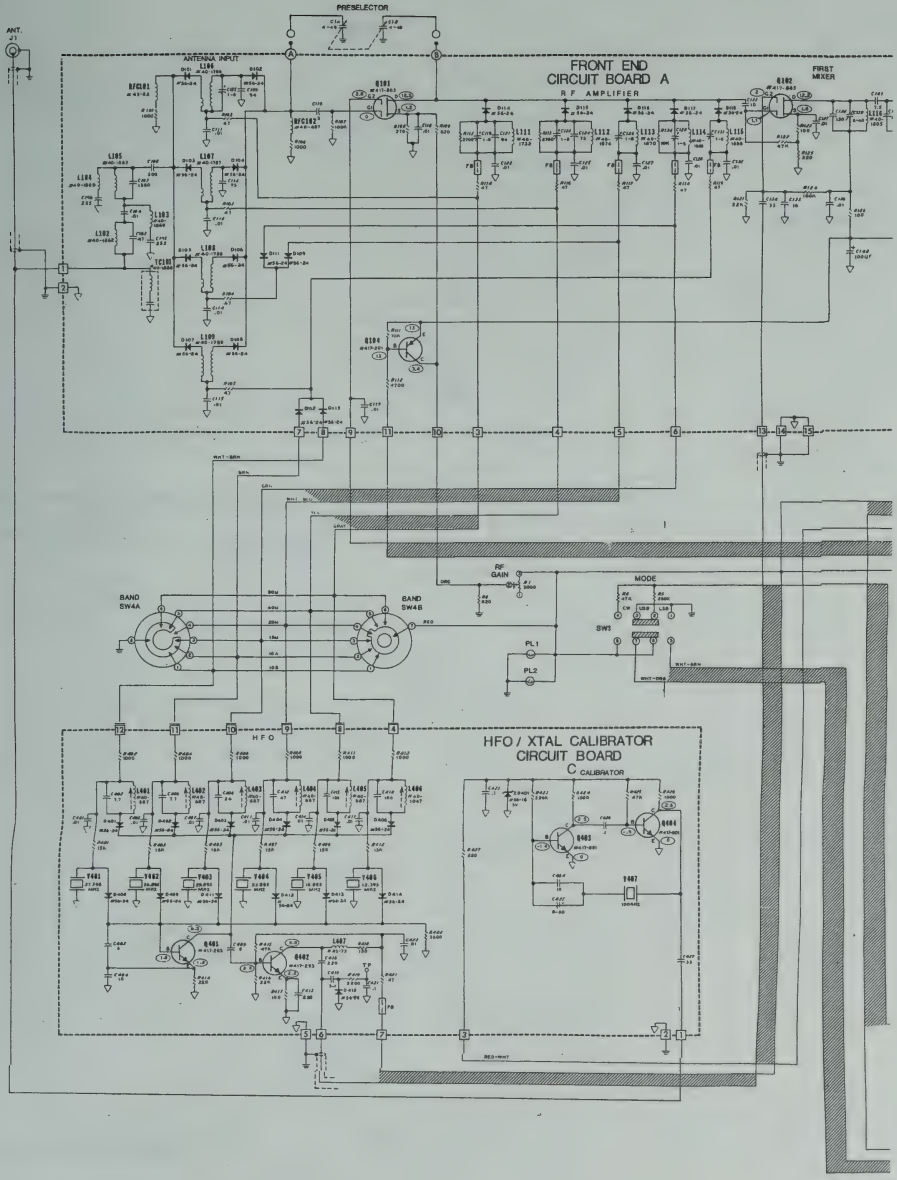
TRANSISTORS

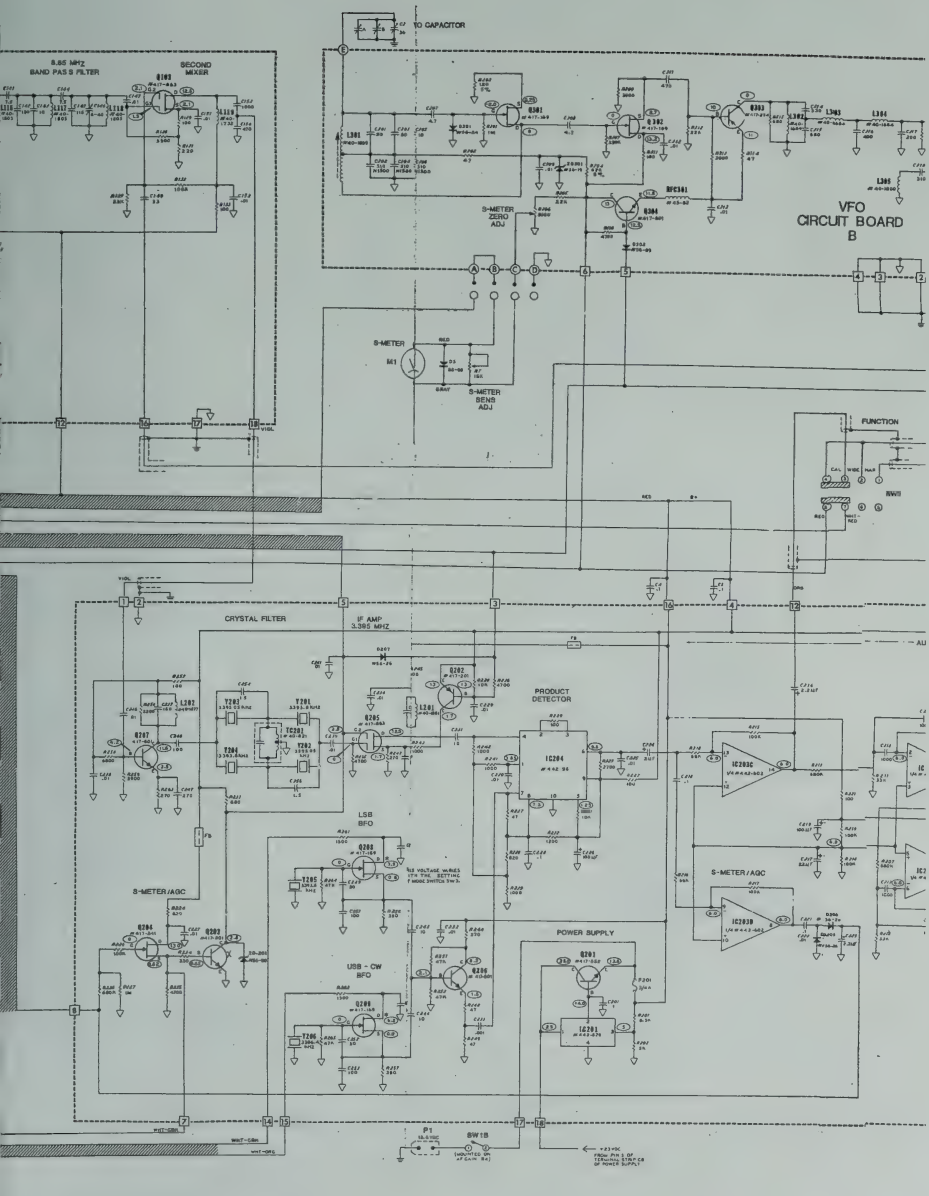
HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	BASING DIAGRAM
417-293	2N5770	Q401, Q402	D
417-169	MPF105	Q208, Q209, Q301, Q302	C
417-852	TIP31	Q201	G
417-201	X29A829	Q104, Q202	A OR B
417-234	2N3638A	Q303	D OR F
417-241	EL131	Q204	C
417-801	MPSA20	Q203, Q206, Q207, Q304, Q403	D
417-863	MFE131	Q101, Q102, Q103, Q205	E

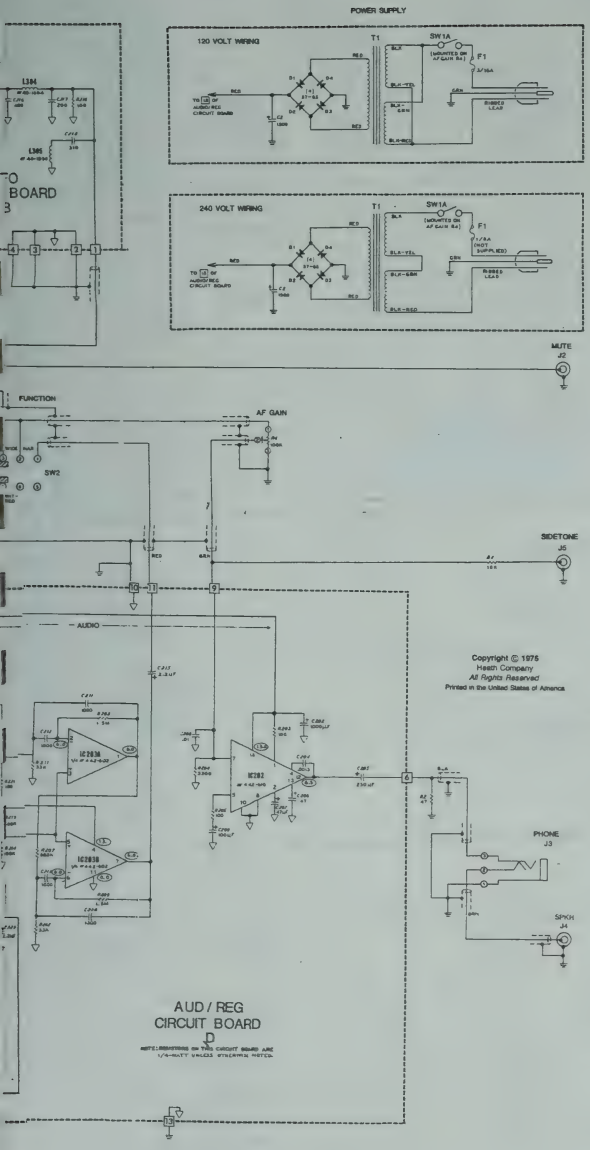


INTEGRATED CIRCUITS

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
442-96	MC1496G	IC204	
443-626	UA78MGT4C	IC201	
442-602	LM324N	IC203	
442-610	TBA820L	IC202	


PRESELECTOR
ANT.
ANTENNA INPUT
FRONT END
CIRCUIT BOARD A
R F AMPLIFIER
FIRST
MIXER
RF
GAIN
MODE
BAND
SW4A
BAND
SW4B
SW3
PL1
PL2
HFO
HFO / XTAL CALIBRATOR
CIRCUIT BOARD
C CALIBRATOR


8.85 MHZ
BAND PASS FILTER
SECOND
MIXER
TO CAPACITOR
S-METER
ZERO
ADJ
VFO
CIRCUIT BOARD
B
S-METER
S-METER
BEMB
ADJ
FUNCTION
CRYSTAL FILTER
IF AMP
3.395 MHZ
PRODUCT
DETECTOR
LSB
BFO
S-METER/AGC
USB - CW
BFO
POWER SUPPLY
S-METER/AGC



SCHEMATIC OF THE HEATHKIT® SSB/CW RECEIVER MODEL HR-1680

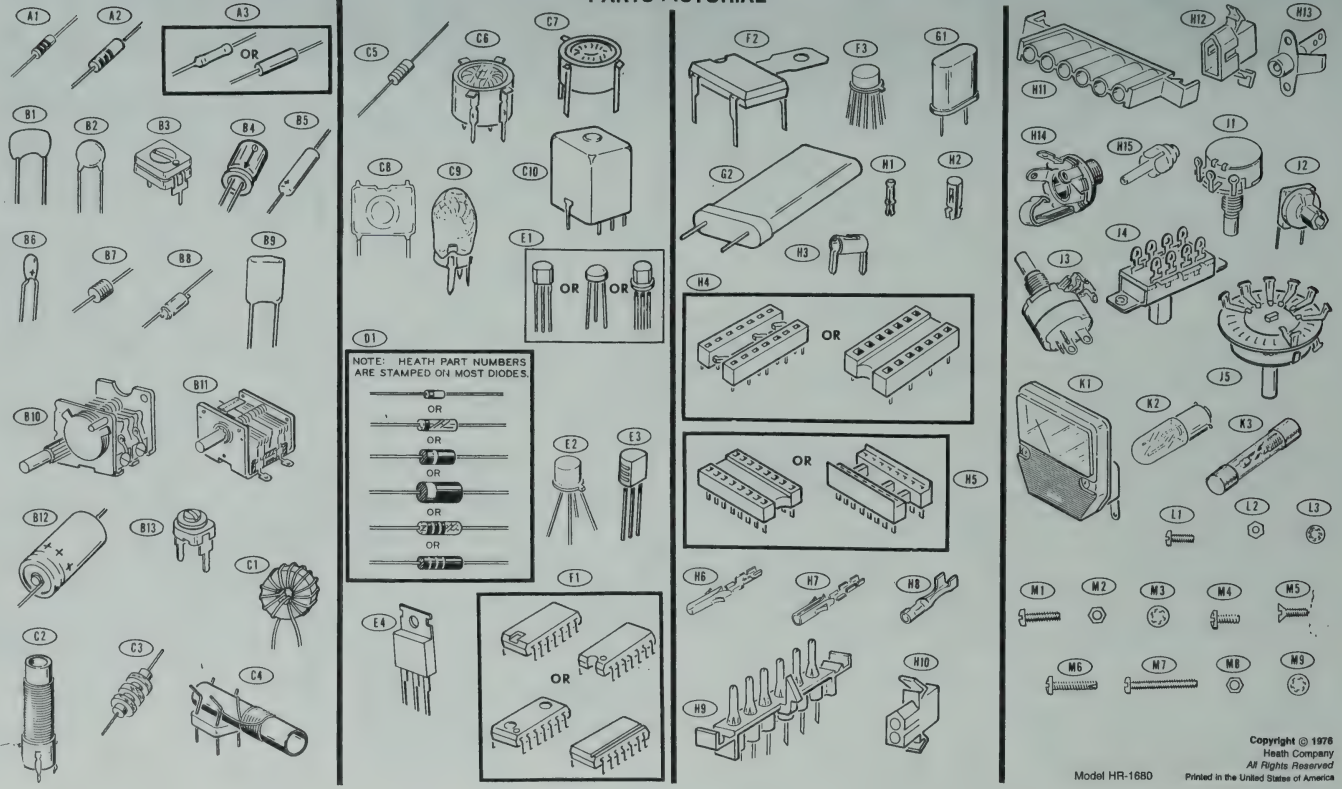
NOTES:

1. COMPONENT NUMBERS ARE IN THE FOLLOWING GROUPS:
   1-99 PARTS MOUNTED ON THE CHASSIS.
   100-199 PARTS MOUNTED ON THE FRONT END CIRCUIT BOARD.
   200-299 PARTS MOUNTED ON THE AUD/REG CIRCUIT BOARD.
   300-399 PARTS MOUNTED ON THE VFO CIRCUIT BOARD.
   400-499 PARTS MOUNTED ON THE HFO/XTAL CALIBRATOR CIRCUIT BOARD.
2. ALL RESISTORS ARE 1/2 WATT, 10% TOLERANCE UNLESS OTHERWISE NOTED. RESISTOR VALUES ARE IN OHMS. K=1000, M=1,000,000.
3. CAPACITORS LESS THAN 1 ARE IN µF (MICROFARADS). ALL OTHER CAPACITORS ARE IN pF (PICOFARADS) UNLESS OTHERWISE NOTED.
4. ARROWS AT CONTROLS INDICATE CLOCKWISE ROTATION, VIEWED FROM THE SHAFT END OF THE CONTROL.
5. ⬭ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASURED WITH A HIGH IMPUT IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES ARE ±20%.
6. ▽ THIS SYMBOL INDICATES A CIRCUIT BOARD GROUND.
7. ⏚ THIS SYMBOL INDICATES CHASSIS GROUND.
8. □ THIS SYMBOL WITH A NUMBER INDICATES A CIRCUIT BOARD EDGE CONNECTOR.
9. ○ THIS SYMBOL WITH A LETTER INDICATES A PCB PIN.
10. TP= TEST POINT
    FB= FERRITE BEAD
11. SWITCHES ARE SHOWN IN THE FOLLOWING POSITIONS:
    MODE: USB
    FUNCTION: CAL
    BAND: 20

ILLUSTRATION BOOKLET

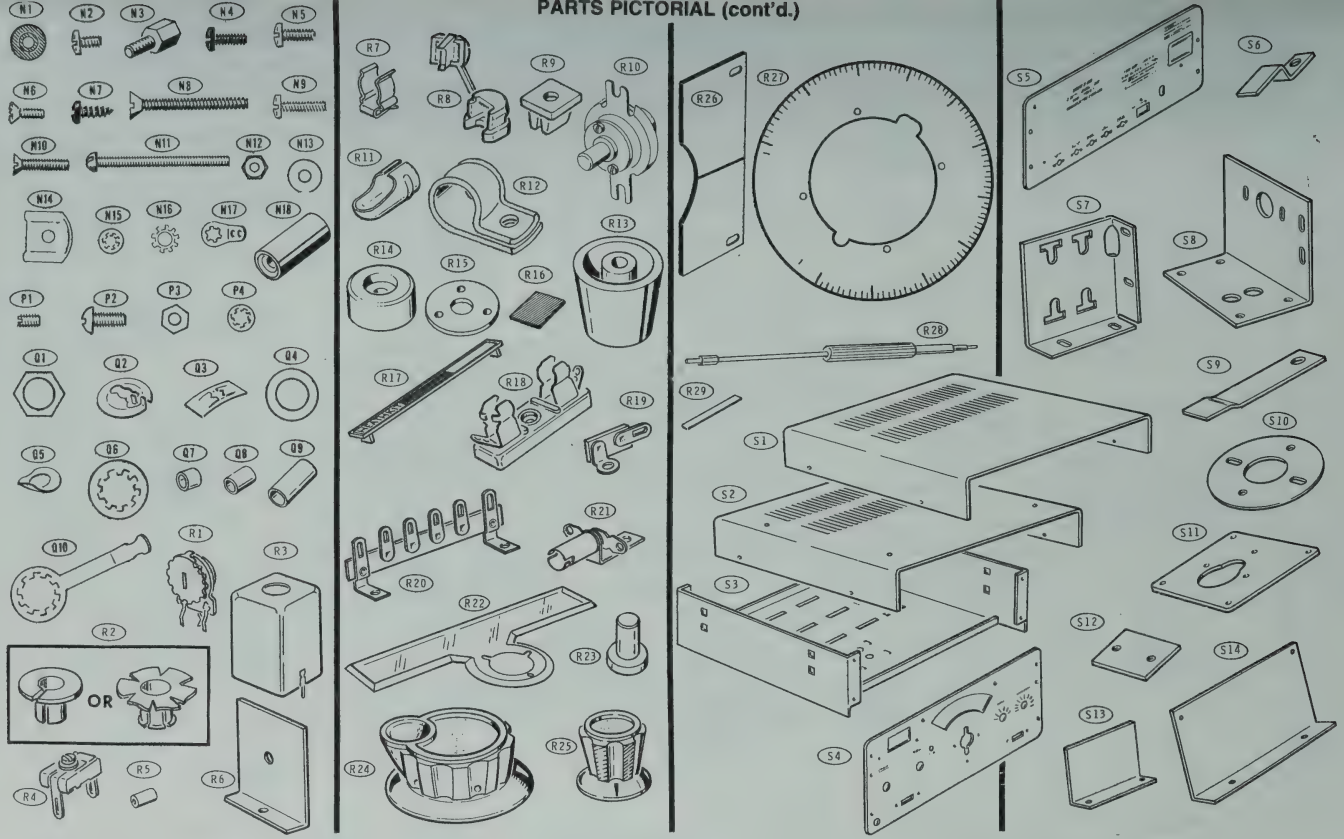
Part of 595-1830-04

PARTS PICTORIAL



Model HR-1680

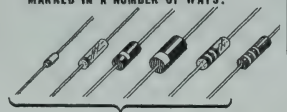
PARTS PICTORIAL (cont'd.)



CIRCUIT BOARD DETAILS

When you install a diode, first locate the banded end of the diode.

THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.

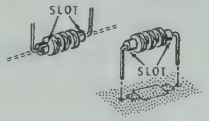


BANDED END

Match the banded end of the diode with the band mark on the circuit board. Then install the diode. A DIODE WILL NOT WORK IF INSTALLED BACKWARD.

Detail A

When you install a choke, bend the leads toward the slot in the choke body to avoid placing any strain on the leads of the choke winding. Then install the choke as shown.

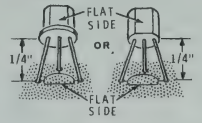


Detail B

When you install a toroid coil, do not remove the coil from its envelope until you are ready to mount it. Then start the leads through their holes in the top of the board. Grasp the lead ends on the foil side of the board and pull the coil down onto the board. Solder the leads as you install each coil. Then cut off the excess lead lengths.

Detail C

When you install this transistor, first line up the flat on the transistor with the outline of the flat on the circuit board. (The transistor may be either of the two types shown below.) Bend the center lead of the transistor forward or backward as required; then insert the transistor leads into the corresponding holes in the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

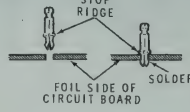


Detail D

When you install a disc capacitor, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.

Detail E

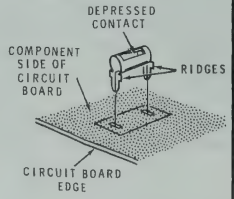
When you install a PCB pin (#432-121), push the pin down firmly against the top of the circuit board. Solder each pin as you install it.



Detail F

Install circuit board connectors in the following manner:

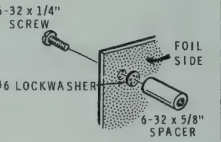
1. Note that inside each connector the spring contact is depressed on one end. This depressed end of the connector should face away from the edge of the circuit board.
2. Insert the mounting tabs through the circuit board until the ridges of the connector are firmly against the circuit board.
3. Look at the row of connectors to make sure the depressed end of the contact of each connector is toward the center of the circuit board.
4. Solder the tabs to the foil.



Detail G

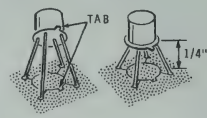
When you install a ferrite bead, use a 1" length of small bare wire to mount the bead to the circuit board.

Detail H



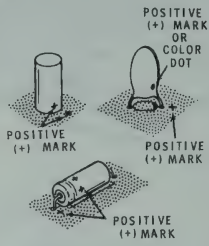
Detail J

When you install this type of transistor, first line up the tab on the transistor with the tab outline on the circuit board. Insert the transistor leads into the corresponding holes in the circuit board. Solder each lead to the foil and cut off the excess lead lengths.



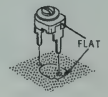
Detail K

When you install electrolytic and tantalum capacitors be sure to match the positive (+) mark or color dot on the capacitor with the positive (+) mark on the circuit board as shown.

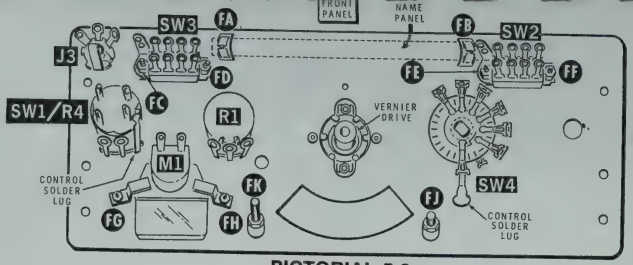


Detail L

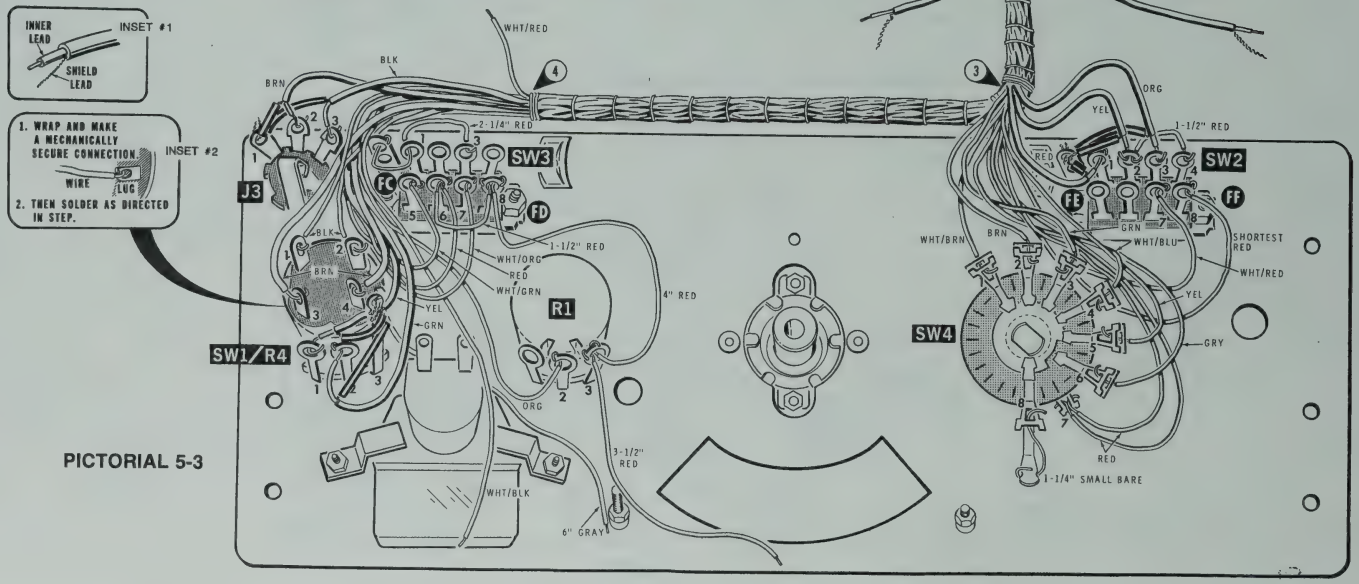
When you install this type of trimmer capacitor, be sure to line up the flat on the capacitor with the outline of the flat on the circuit board. Then insert the lugs into the corresponding holes in the circuit board and solder them to the foil.



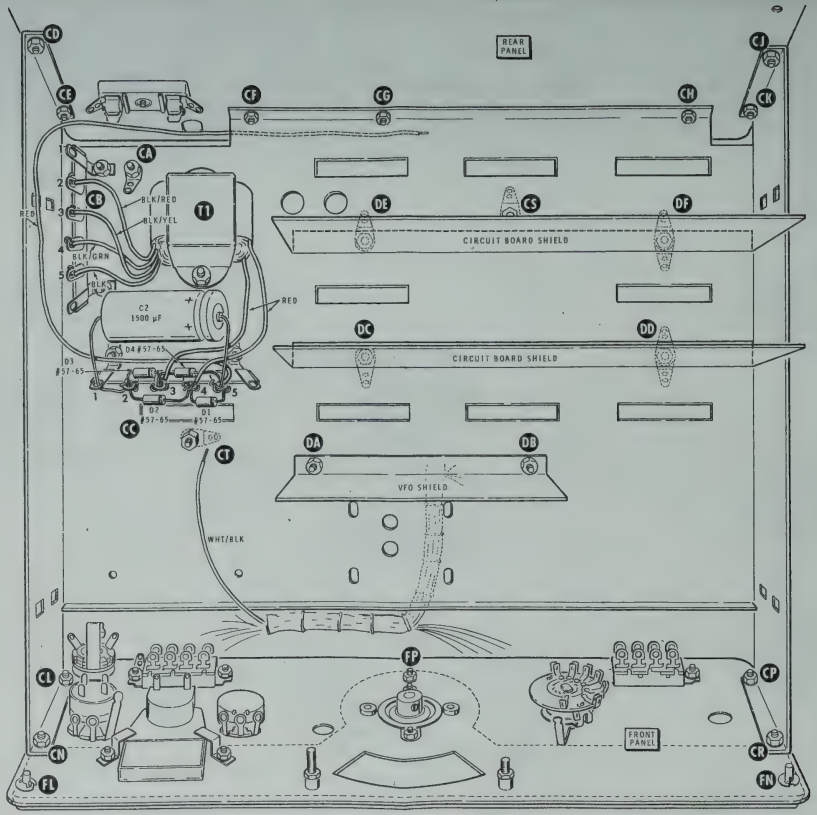
Detail M



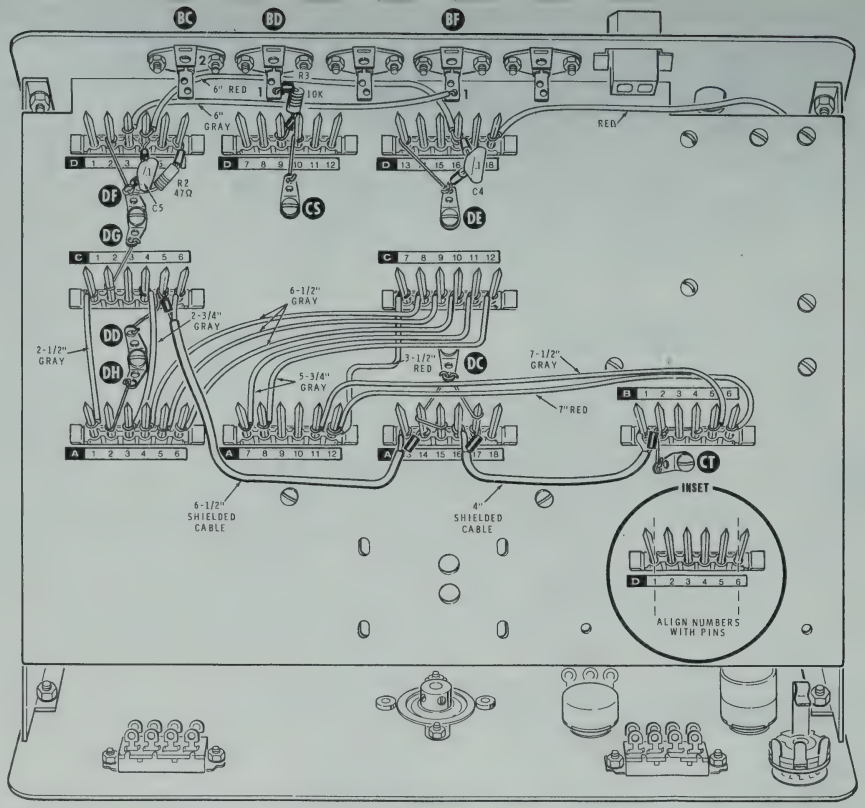
PICTORIAL 5-2



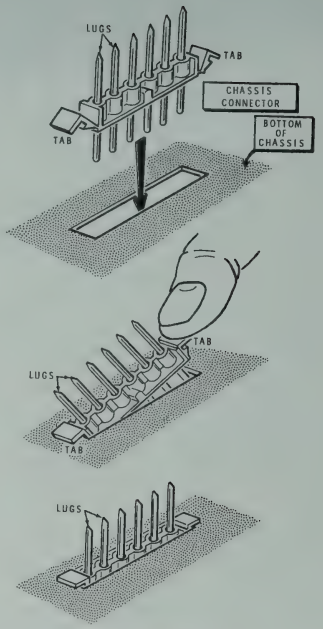
PICTORIAL 5-3



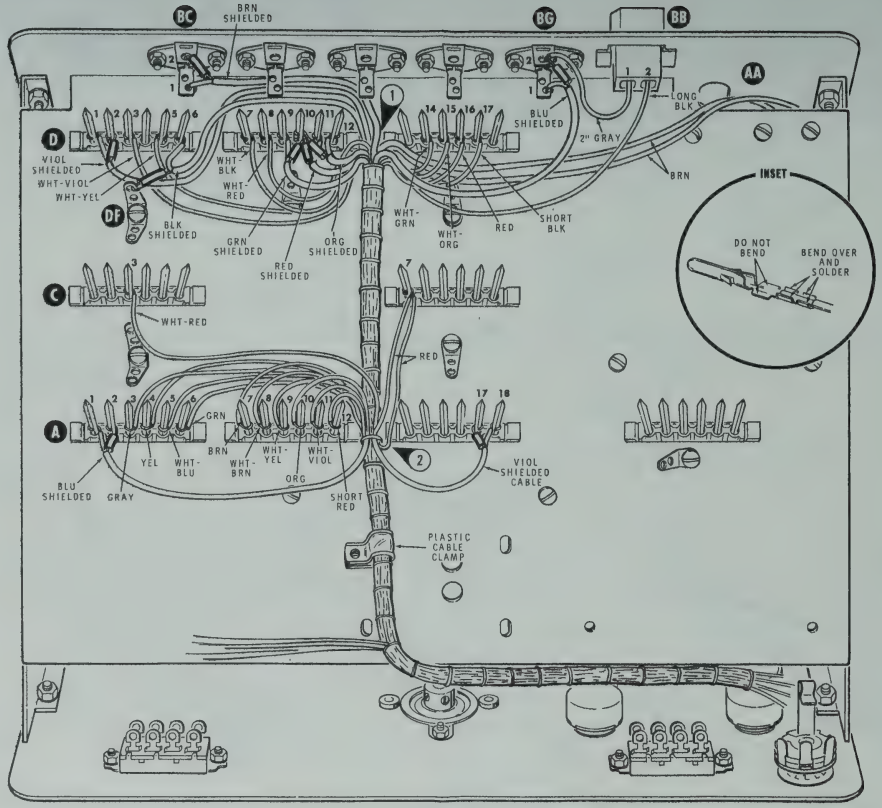
PICTORIAL 5-4



PICTORIAL 5-5

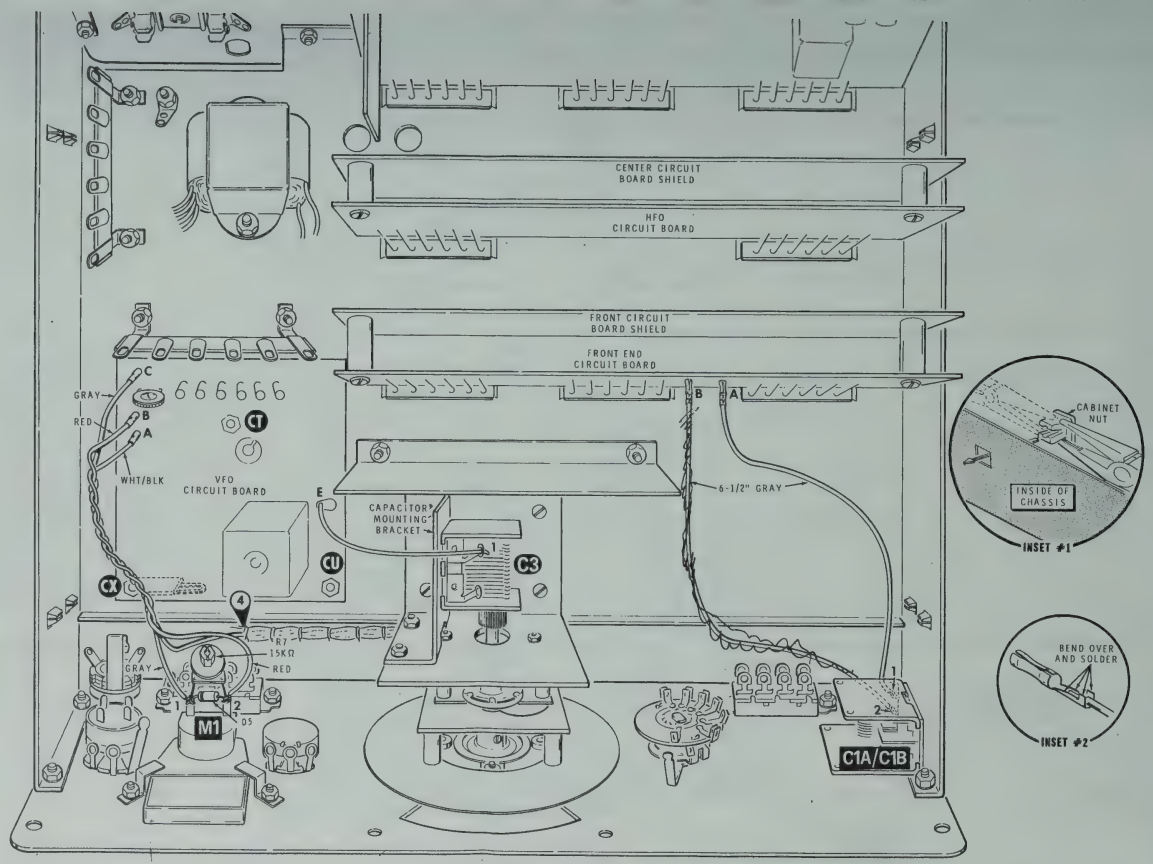


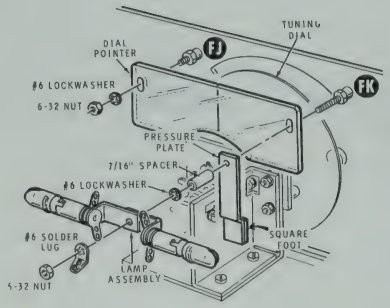
Detail 5-5B



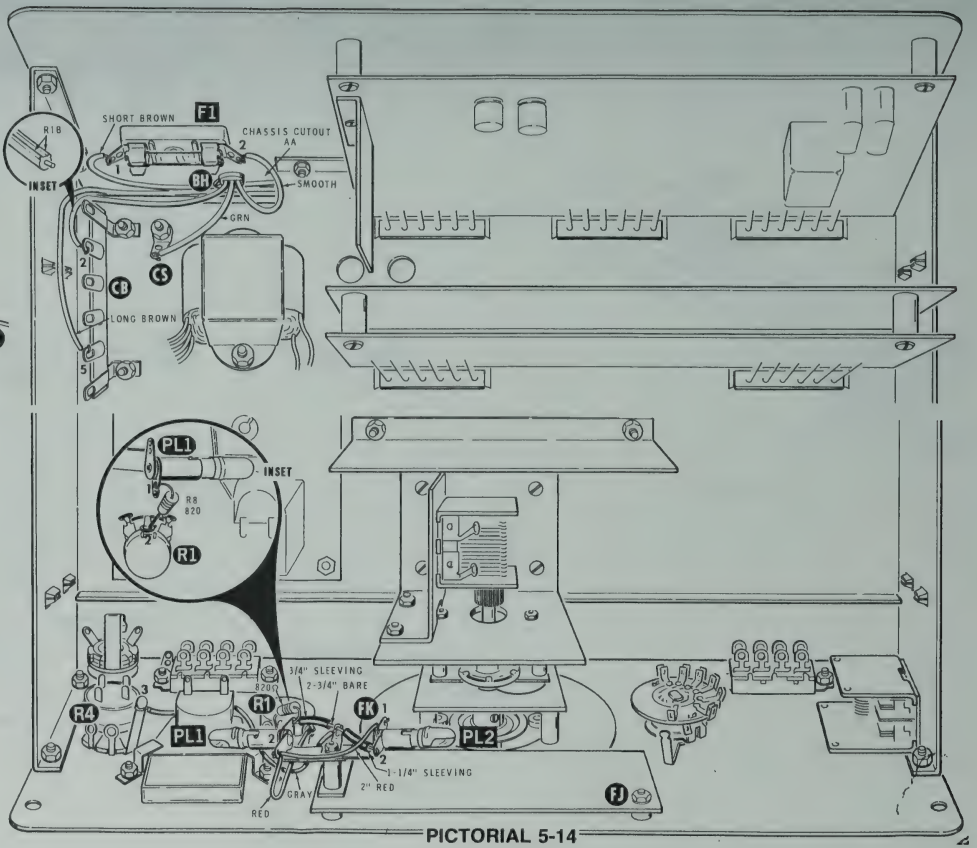
PICTORIAL 5-6

PICTORIAL 5-11





PICTORIAL 5-13



PICTORIAL 5-14

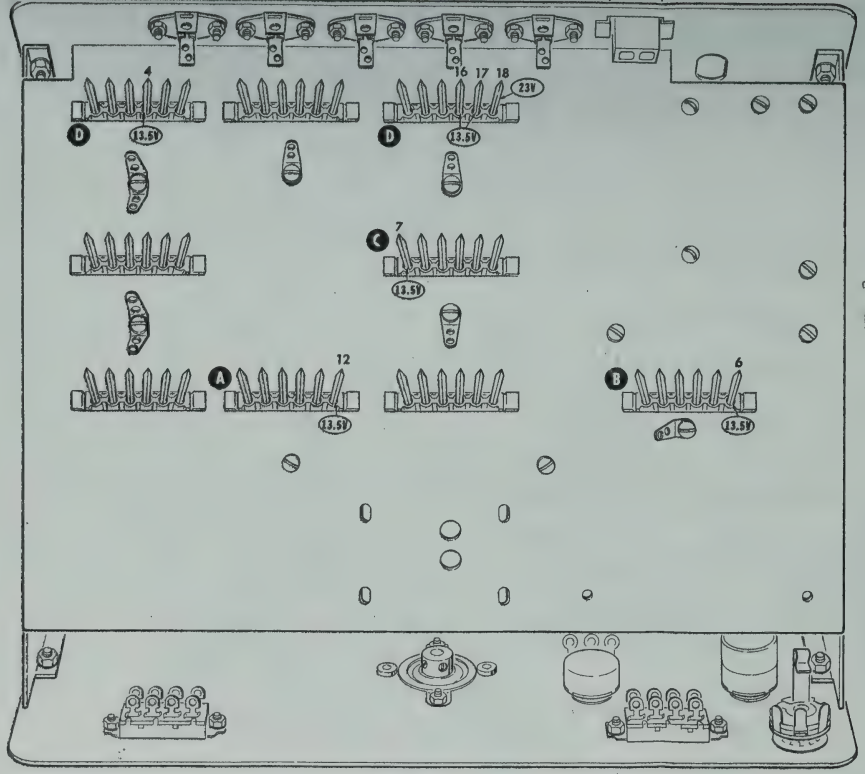


Figure 1-1

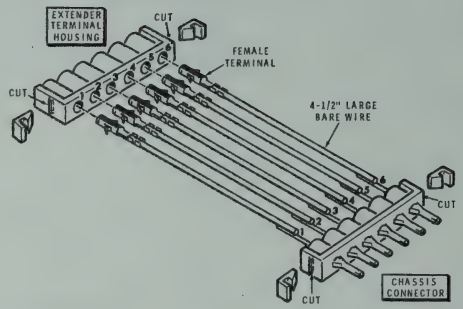


Figure 2-3

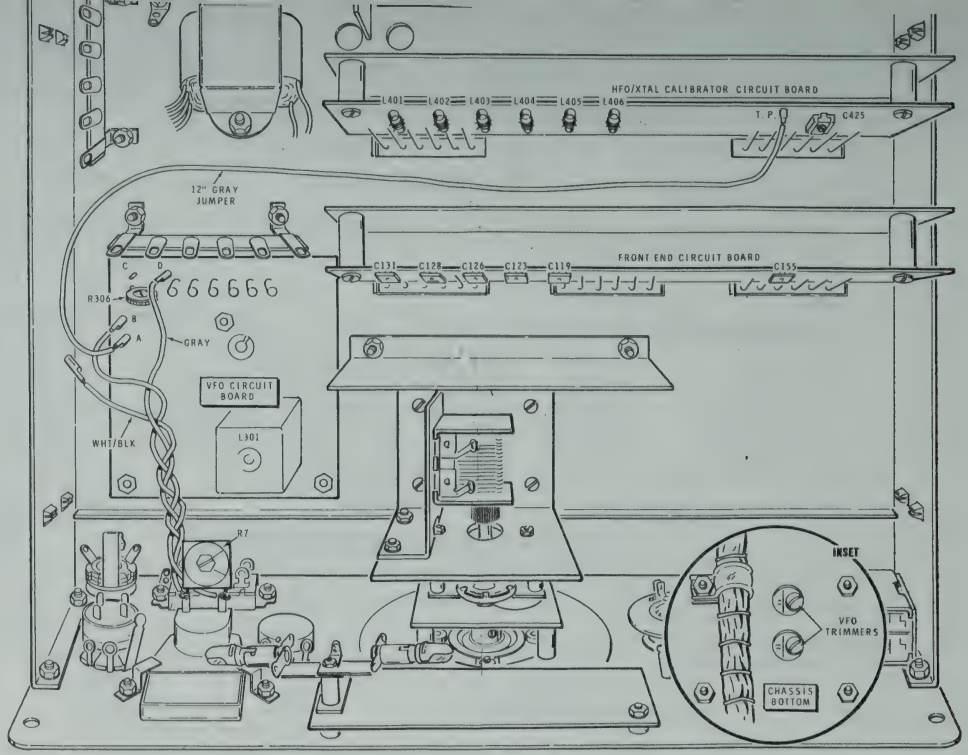

HFO/XTAL CALIBRATOR CIRCUIT BOARD
L401
L402
L403
L404
L405
L406
T. P.
C425
12" GRAY JUMPER
FRONT END CIRCUIT BOARD
C131
C128
C126
C123
C119
C155
C
D
R306
B
A
GRAY
VFO CIRCUIT BOARD
L301
WHT/BLK
R7
INSET
VFO TRIMMERS
CHASSIS BOTTOM

Figure 2-4

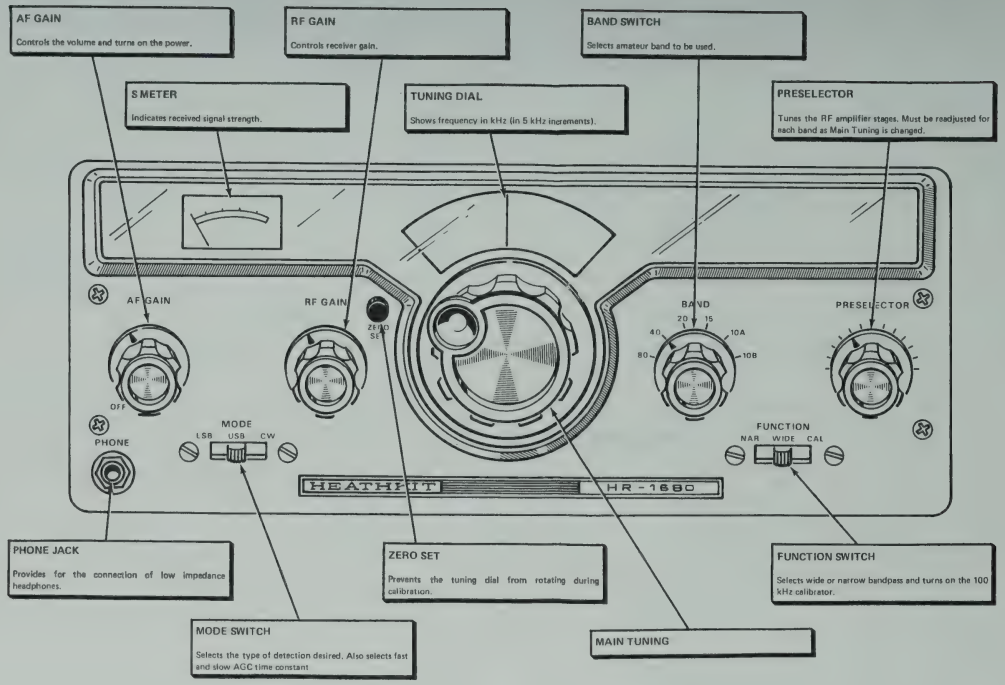
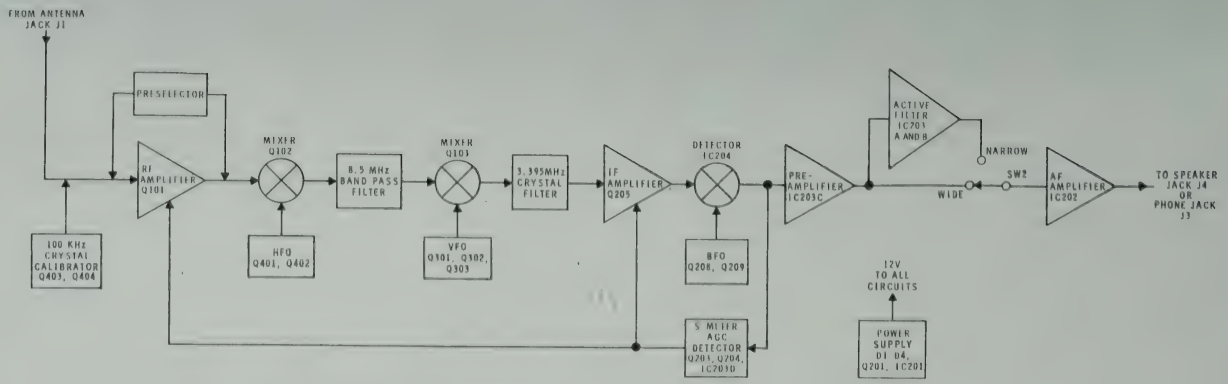

AF GAIN
Controls the volume and turns on the power.
RF GAIN
Controls receiver gain.
BAND SWITCH
Selects amateur band to be used.
S METER
Indicates received signal strength.
TUNING DIAL
Shows frequency in kHz (in 5 kHz increments).
PRESELECTOR
Tunes the RF amplifier stages. Must be readjusted for each band as Main Tuning is changed.
AF GAIN
RF GAIN
ZERO SET
BAND
PRESELECTOR
OFF
PHONE
MODE
LSB USB CW
FUNCTION
NAR WIDE CAL
HEATHKIT
HR-1680
PHONE JACK
Provides for the connection of low impedance headphones.
ZERO SET
Prevents the tuning dial from rotating during calibration.
FUNCTION SWITCH
Selects wide or narrow bandpass and turns on the 100 kHz calibrator.
MODE SWITCH
Selects the type of detection desired. Also selects fast and slow AGC time constant
MAIN TUNING

Figure 4-1



BLOCK DIAGRAM